Monterey Bay Regional Energy Plan

April 11, 2006

Part II of II

AMBAG
ASSOCIATION OF
MONTEREY BAY AREA
GOVERNMENTS

Nicolas Papadakis, Executive Director
Association of Monterey Bay Area Governments (AMBAG)
P.O. Box 809
Marina, CA 93933-0809

Prepared by:

KJK&A
K. J. KAMMERER & ASSOCIATES

Kurt J. Kammerer
K. J. Kammerer & Associates, Inc.
P.O. Box 60738
San Diego, California 92166

DISCLAIMER

This report was prepared as the result of work sponsored by the California Energy Commission. It does not necessarily represent the views of the Energy Commission, its employees, or the State of California. The Energy Commission, the State of California, its employees, contractors and subcontractors make no warrant, express or implied, and assume no legal liability for the information in this report; nor does any party represent that the uses of this information will not infringe upon privately owned rights. This report has not been approved or disapproved by the California Energy Commission nor has the California Energy Commission passed upon the accuracy or adequacy of the information in this report.

Note: An electronic version of this Plan is available on Compact Disc (CD) that includes Parts I, II and the Appendices as well as useful links to additional background resources and source documents for further review.

TABLE OF CONTENTS (Part II)

1 Introduction to Part II

This is Part II of II the Association of Monterey Bay Area Governments (AMBAG) Regional Energy Plan. Part II incorporates the Background Energy Report and is intended to provide more detailed background and supporting information for the objectives, goals and action steps outlined in Part I.

2 Recent Local Energy Activities

To date, the region has accomplished a significant amount of energy efficiency and use of alternative sources, such as solar photovoltaics (PV). In addition, there are several organizations based in the region that have played a leadership role in offering programs to consumers. Although not a complete inventory of accomplishments, this section is intended to provide a brief overview of some of the specific activities that have been undertaken in the region.

2.1 Individual Public Agency Efforts

2.1.1 ABAG/AMBAG Government Partnership Program

Recently, several AMBAG agencies, including the Counties of Monterey and Santa Cruz, and the Cities of Santa Cruz and Seaside, have committed to participating in the joint Association of Bay Area Governments (ABAG)/AMBAG Local Government Partnership Program (LGEP)[1]. LGEP provides technical assistance and information services to assist small to medium-sized cities, counties and special districts to complete energy efficiency projects in public facilities and to promote energy efficiency within their communities.

2.1.2 City of Santa Cruz

In response to the most recent energy crisis, the City of Santa Cruz embarked on an aggressive program to address its energy challenges and opportunities. Their efforts include the following:

- Creation of an "Energy Crisis Conservation Program" in January 2001. This program created a city-wide Energy Task Force that acted as an advisory body to the Public Works Commission. The Group created recommendations to keep energy dollars in the community, increase housing affordability by lowering energy costs to households, help bring stability and predictability to local energy budgets, and reduce the City's contribution to environmental pollution, global warming, and the depletion of natural resources. The Task Force completed its work in July 2003.

- Expansion of the City's Wastewater Treatment Facility (WWTF) methane digester gas-fueled cogeneration system to increased the power output by 26% from 650-kilowatt (kW) to 820 kW. The system produces approximately half of the energy requirements at the WWTF. The project took advantage of co-funding from the Santa Cruz County Sanitation District and California Energy Commission grants.

[1] http://www.abag.ca.gov/lgep/energy_programs.html

Figure 1: City of Santa Cruz's Wastewater Treatment Facility Renewable Cogeneration System

- Installation of three solar photovoltaic (PV) systems, including a 15 kW system on City Hall, a 50.4 kW system at the WWTF, and a 47.6 kW system at the Corporate Yard. Combined, these systems produce nearly 170,000 kilowatt hours (kWh) (the equivalent of about 55 homes) and save the City about $29,000 each year.

- Formed a Green Building Working Group of local builders, architects and interested residents to draft a green building policy, standards, processes and implementation plan for the City of Santa Cruz.

- Established a target for the City to obtain 30% of its power from renewables by 2015 in support Senate Bill (SB) 532 (Sher, Palo Alto), which would require the State to increase its renewable portfolio to 20% by the year 2010.

2.2 Private Organization Energy Activities

2.2.1 <u>Ecology Action- Right Lights Program</u>

Ecology Action, a Santa Cruz-based environmental non-profit organization, was awarded a $6.2 million dollar publicly-funded contract from the California Public Utilities Commission (CPUC) to help small businesses in San Mateo, Santa Clara, Santa Cruz, Monterey, and San Benito Counties to obtain major energy cost reductions by updating their inefficient lighting systems.

The program, called RightLights, targets smaller nonresidential customers such as small retail, hotel/motel, light manufacturing, restaurants, and others that may have missed out on big utility-run rebate programs. Participants receive a free on-site lighting survey that suggests cost-effective upgrades that can cut lighting costs by up to 50%, and the program helps underwrite the retrofit costs. The program has goals to reduce its participants electricity demand by over 4,000 kilowatts (kW) and consumption by over 16 million kilowatt-hours (kWh), which would result in a future cost savings of over $2.2 million per year.

2.2.2 Central Coast Energy Services, Incorporated

Central Coast Energy Services, Inc. is a non-profit organization established in 2004. The Watsonville-based organization provides energy conservation, consumer education and advocacy, home improvement, utility assistance, job training, and other services to people in need through its "Energy Services Team." The organization serves Monterey and Santa Cruz counties and San Benito with weatherization services only. The energy savings as a result of the program from June 2001 through July 2003 were in excess of 926,000 kWh and 36,000 therms, representing a total annual cost savings of over $175,000.

2.2.3 Pacific Gas & Electric (PG&E)

PG&E offers a number of energy efficiency, demand response, and self-generation programs that assist all sectors. A complete list of programs offered by PG&E and other entities is found in Appendix C.

3 Energy Efficiency

3.1 Overall Energy Efficiency Potential

Recent studies[2] have been completed on the statewide potential for electricity and natural gas savings for both the commercial and residential sectors. These studies assumed various scenarios driven by different levels of investment in energy efficiency given that the investment would be economically superior to alternative supply options (e.g. generation). The overall technical and economic savings potential for PG&E's service territory[3] is shown in Tables 1 (Electricity) and 2 (Natural Gas), along with AMBAG region's proportionate share of this potential. The estimated savings represent about 1% per year reduction in energy consumption (assuming a continued statewide growth of 1.7% per year). By 2013, the cumulative savings would represent about 10% of forecast energy consumption in 2013.

The referenced studies do not call out the actual potential for the AMBAG region. These figures were derived by the author of this report calculating the proportionate share of the energy savings potential based on the region's ratio of overall consumption to that of PG&E (5.1 percent).

Table 1: Electricity Savings Potential through 2013

PG&E Electricity Savings Potential (2002 through 2011)		
	Technical	**Economic**
Total Study PG&E Potential (GWh)	14,771	11,079
Total Study AMBAG Potential (GWh)	753	565

Table 2: Natural Gas Savings Potential through 2013

Natural Gas Savings Potential (2002 through 2011)		
	Technical	**Economic**
PG&E (MM therms)	1,265	363
AMBAG Region (MM therms)	59	17

The assumption that the AMBAG region could contribute a proportionate share of the electricity and natural gas savings potential is a simplified assumption that is the best that can be achieved at this point in time. It is difficult to accurately determine the exact potential savings without additional local data collection and analysis. On one hand, the energy savings potential from measures like air-conditioning would be expected to be less in the AMBAG region due to its relatively moderate climate. However, it is also likely that savings for measures like lighting could be higher. Many believe that the adoption rate of energy

[2] CALIFORNIA STATEWIDE COMMERCIAL SECTOR ENERGY EFFICIENCY POTENTIAL STUDY, July 9, 2002; CALIFORNIA STATEWIDE RESIDENTIAL SECTOR ENERGY EFFICIENCY POTENTIAL STUDY, April 2003; And CALIFORNIA STATEWIDE COMMERCIAL SECTOR NATURAL GAS ENERGY EFFICIENCY POTENTIAL STUDY, May 14, 2003.

[3] Statewide energy efficiency goals are outlined in CPUC Decision 04-09-060, "INTERIM OPINION: ENERGY SAVINGS GOALS FOR PROGRAM YEAR 2006 AND BEYOND," dated September 23, 2004.

efficiency measures (e.g. high efficiency lighting) is somewhat lower in geographic areas outside major metropolitan areas because the industry infrastructure to support energy efficiency retrofits is not as active or robust. For this reason, it is likely that a higher percentage of savings could be achieved from the region from measures like lighting, motors, heating and ventilation.

The referenced statewide potential studies also did not include an analysis of the savings that could be derived from new construction projects. Additionally, they assumed the use of commercially available technologies at the time the study was completed. Both of these factors will contribute to their results being conservative (actual savings potential should be higher). The investment in energy efficiency research and development by the State of California is significant. The California Energy Commission (CEC) manages the Public Interest Energy Research (PIER) Program and the investor-owned utilities (IOUs) managing emerging technologies research. The combined annual investment between these programs is approximately $15 to 20 million per year and growing. It is likely that this research will continue to deliver technologies and processes that are superior to that which is available today.

An example of the impacts of emerging technologies is exit sign lighting technologies. In the late-1990's, incandescent exit signs that consumed 30-50 watts were very common and were being replaced with compact fluorescent lamps that consumed 10-16 watts. It was only a few short years later that light emitting diode (LED) lamps reached a price-point that allowed for integration with exit signs to further reduce energy consumption to less than 3 watts. As a result, the recommended practice for exit signs quickly shifted to emphasize LED technology. Although all exit signs have not yet been converted to LEDs, the potential energy savings for this measure alone represents about 1.4% of the State's total electricity consumption. The total statewide electricity cost savings for this measure alone would exceed $430 million per year[4].

Another example of the significance of the impact on future emerging technologies is the use of LEDs in traffic lamps. LEDs in this application were considered an emerging technology in the late 1990's. The final barrier to wide-scale adoption was the lack of a standard by the California Department of Transportation (their standard was based on incandescent technology). Once this standard was in place, the utilities began providing incentives for the adoption of this technology. Today, more that 65 percent of the traffic signal signals in California use LED lamps, saving about 90% energy consumption per lamp and over $30 million per year in energy costs[5].

3.1.1 Electricity Savings Goals

In a recent CPUC decision[6], the state established aggressive energy efficiency goals for the investor-owned utilities, as follows:

[4] Assumes 11 million exits signs in California. All converted from incandescent to CFL. Electricity price of $0.12 per kWh.
[5] California Energy Commission. Integrated Energy Policy Report 2004 Update. Light Emitting Diode (Led) Traffic Signal Survey Results, Staff Report. January 2005. CEC-400-2005-003.

- Cumulative annual electricity savings of 23,182 GWh (about 1% of total statewide consumption)
- Cumulative electricity peak demand savings of 4,855 MW (about 1% of peak demand), and
- Cumulative annual gas savings of 67 million therms (about 0.5% of total statewide consumption).

These goals suggest that energy efficiency efforts should be able to capture about 70% of the economic potential and 90% of the maximum achievable potential for electric energy savings over a 10-year period. Energy efficiency efforts should meet 55-59% of the IOUs' incremental electric energy needs between 2004 and 2013.

Tables 3 (Electricity) and Table 4 (Natural Gas) show the savings goals adopted for PG&E, as well as the "proportionate" share of these goals as applied to the AMBAG region. This assumes that the AMBAG region contributes a proportionate share of the energy savings each year to the overall PG&E energy efficiency program efforts (as discussed in the previous section).

Table 3: PG&E's Electricity Efficiency Goals Through 2013 and the AMBAG Region's Proportionate Contribution

PG&E Total Electricity Savings Goals									
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total Annual Electricity Savings (GWh/yr)	744	829	944	1,053	1,067	1,015	1,086	1,173	1,277
Total Cumulative Savings (GWh)	1,487	2,317	3,260	4,313	5,381	6,396	7,483	8,656	9,933
Total Peak Savings (MW)	323	503	708	936	1,168	1,388	1,624	1,878	2,156
AMBAG Region's Share of PG&E Electricity Savings Goals									
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total Annual Electricity Savings (GWh/yr)	37.9	42.3	48.1	53.7	54.4	51.8	55.4	59.8	65.1
Total Cumulative Savings (GWh)	75.8	118.2	166.3	220.0	274.4	326.2	381.6	441.5	506.6
Total Peak Savings (MW)	16.5	25.7	36.1	47.7	59.6	70.8	82.8	95.8	110.0
Total Estimated Cumulative Savings ($ Millions)	**$ 11.4**	**$ 17.7**	**$ 24.9**	**$ 33.0**	**$ 41.2**	**$ 48.9**	**$ 57.2**	**$ 66.2**	**$ 76.0**

Table 4: PG&E's Natural Gas Efficiency Goals Through 2013 and the AMBAG Region's Proportionate Contribution

PG&E Total Natural Gas Savings Goals (2005-2013)									
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total Annual Natural Gas Savings (MMTh/yr)	9.8	12.6	14.9	17.4	20.3	21.1	22.0	23.0	25.1
Total Cumulative Natural Gas Savings (MMTh)	9.8	22.4	37.3	54.7	75.0	96.1	118.1	141.1	166.2

AMBAG Region's Share of PG&E Natural Gas Goals (2005-2013)									
	2005	2006	2007	2008	2009	2010	2011	2012	2013
Total Annual Natural Gas Savings (MMTh/yr)	0.46	0.59	0.70	0.82	0.96	0.99	1.04	1.08	1.18
Total Cumulative Natural Gas Savings (MMTh)	0.46	1.05	1.76	2.57	3.53	4.52	5.56	6.64	7.82
Total Estimated Cumulative Savings ($ Millions)	**$ 0.5**	**$ 1.1**	**$ 1.8**	**$ 2.6**	**$ 3.5**	**$ 4.5**	**$ 5.6**	**$ 6.6**	**$ 7.8**

Note that Tables 3 and 4 estimate the cumulative cost savings[7] through 2013 for the AMBAG region if these energy efficiency targets are met to be a total of nearly $83.8 million

[6] CPUC Decision 04-09-060, dated September 23, 2004.
[7] Assumes a PG&E system-wide average electricity price of $0.15 per kilowatt hour. Future savings are in today's dollars.

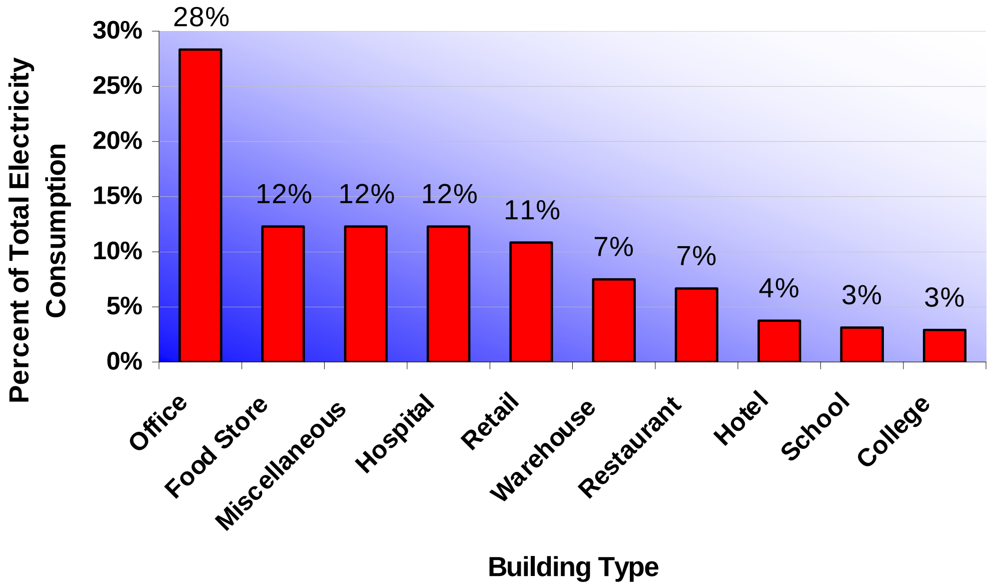
(approximately $76 million for electricity and $7.8 million for natural gas).

3.2 Commercial Energy Efficiency Potential, Program and Measures[8]

3.2.1 Commercial Sector Electricity Use

The total annual energy consumption for the region's commercial sector in 2003 was 2,882 GWh. This represents an estimated annual total energy cost of $432 million[9]. The overall distribution of electricity use in commercial sector statewide is shown in Figure 2. This distribution indicates what building types would have the most gross energy efficiency savings potential. Commercial buildings include most public agency facilities.

Figure 2: Commercial Electricity Consumption by Building Type (Source: CEC, California Energy Demand: 2000-2010.)



The summer peak demand of commercial buildings is shown in Figure 3 and the distribution of end use consumption is shown in Figure 4.

[8] Primary Sources: California Statewide Commercial Sector Natural Gas Energy Efficiency Potential Study, KEMA-XENERGY Inc., May 2003.
[9] Assumes average electricity rate of $0.15 per kilowatt-hour.

Figure 3: California Commercial Peak Demand by End Use

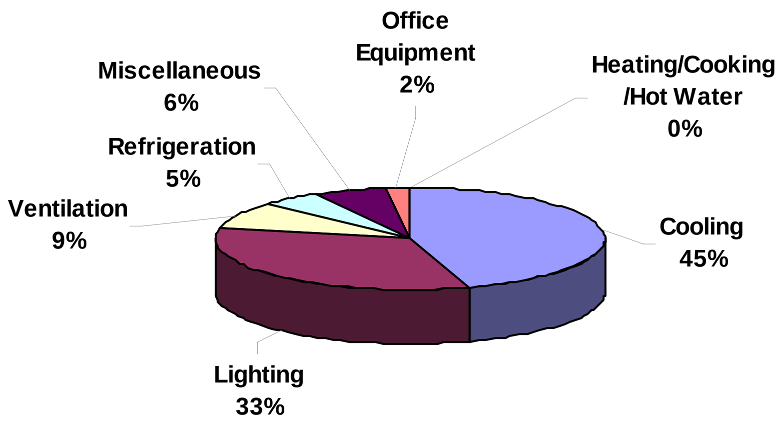
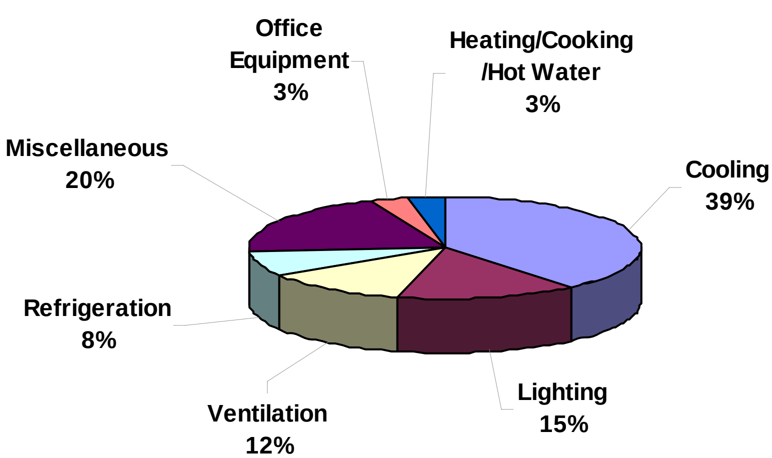


Figure 4: California Commercial Peak Demand by End Use



3.2.2 Commercial Sector Energy Savings Potential

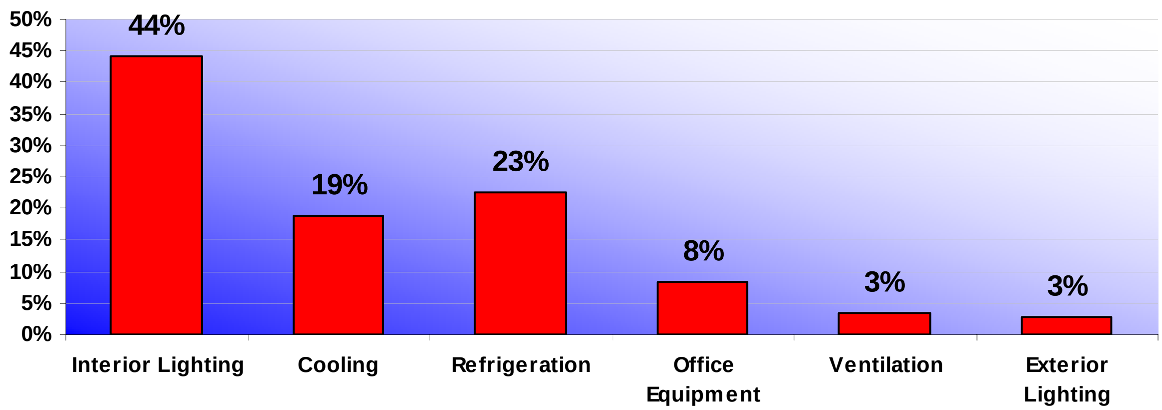
The total commercial technical and economic electricity energy and demand savings potential for PG&E and for the region are shown in Table 5.

Table 5: PG&E Commercial Electricity Savings Potential and Proportionate Share from AMBAG Region

Commercial Electricity Savings Potential (2002 through 2011)		
	Technical	Economic
PG&E (GWh)	5,888	4,249
AMBAG Region (GWh)	330	238
	$ 214	
Commercial Electricity Demand Savings Potential (2002 through 2011)		
	Technical	Economic
PG&E (MW)	1,683	1,133
AMBAG Region (MW)	94	63

Figure 5 shows the distribution of this total energy savings potential by end use.

Figure 5: Commercial Potential Electricity Savings by End Use



3.2.3 Commercial Sector: Energy Efficiency Measures

Table 6 lists the actual end-use measures that were evaluated as part of the commercial electricity energy efficiency potential study. The measures are listed in order of cost-effectiveness (most cost-effective to least), and indicate the total potential savings per measure for the region, the levelized cost of the measure (dollars per kWh) and total potential cost savings for the region. The measures are grouped in terms of cost effectiveness, from most cost-effective to least. For example, Liquid Crystal Display (LCD) monitors consume about 55 watts less than traditional Cathode Ray Tube (CRT) monitors. However, the savings that would accrue over a year (assuming 3,000 hours operation) would not justify the cost of the more expensive monitor technology based on energy cost savings alone. This is not to say that one should not pursue measures that are marginally or least cost-effective. All of these measures should be pursued on equipment replacement. However, it is not as cost-effective as investing in other energy efficiency measures.

Table 6: Commercial Electricity Energy Efficiency Measures, AMBAG Region Potential Energy Savings, Levelized Energy Costs and Total Cost Savings By Measure

Measure	AMBAG Region GWh Savings	Levelized Energy Costs ($/kWh)	AMBAG Region Cost Savings ($ MM)
T8/Electronic Ballast with Reflectors	52	$ 0.007	$ 8.2
Refrigeration	2	$ 0.007	$ 0.4
High-efficiency Chiller	24	$ 0.017	$ 3.9
Refrigeration Controls	23	$ 0.017	$ 3.7
Refrigerator Covers	18	$ 0.021	$ 2.9
Programmable Thermostat	14	$ 0.022	$ 2.3
Compact Fluorescent Lamps	37	$ 0.025	$ 5.9
Exterior Lighting Controls	12	$ 0.026	$ 1.9
Refrigerator Compressors and Motors	62	$ 0.032	$ 10.0
Ventilation Variable Speed Drives (VSD)	23	$ 0.034	$ 3.7
Occupancy Sensors	56	$ 0.048	$ 9.0
Exterior High Pressure Sodium Lamps	16	$ 0.052	$ 2.6
T8/Electronic Ballast	129	$ 0.059	$ 20.7
High-efficiency Direct Expansion Air Conditioner	23	$ 0.066	$ 3.6
High-efficiency Ventilation Motor	8	$ 0.071	$ 1.3
Refrigeration Commissioning	6	$ 0.071	$ 0.9
Office Equipment Power Management	52	$ 0.090	$ 8.3
Energy Management System	12	$ 0.097	$ 1.9
Window Film	11	$ 0.110	$ 1.8
Halogen Lamps	15	$ 0.136	$ 2.4
Chiller Pumps	6	$ 0.148	$ 0.9
Cool Tune-ups	16	$ 0.225	$ 2.5
Cool Roofs	10	$ 0.238	$ 1.6
Perimeter Dimming	86	$ 0.250	$ 13.8
Metal Halide Lamps	14	$ 0.265	$ 2.2
Pre-cooler	4	$ 0.326	$ 0.6
Office Equipment Night Shutdown	6	$ 2.031	$ 0.9
LCD Monitor	8	$ 5.976	$ 1.3

Most Cost-Effective

Marginally Cost-Effective

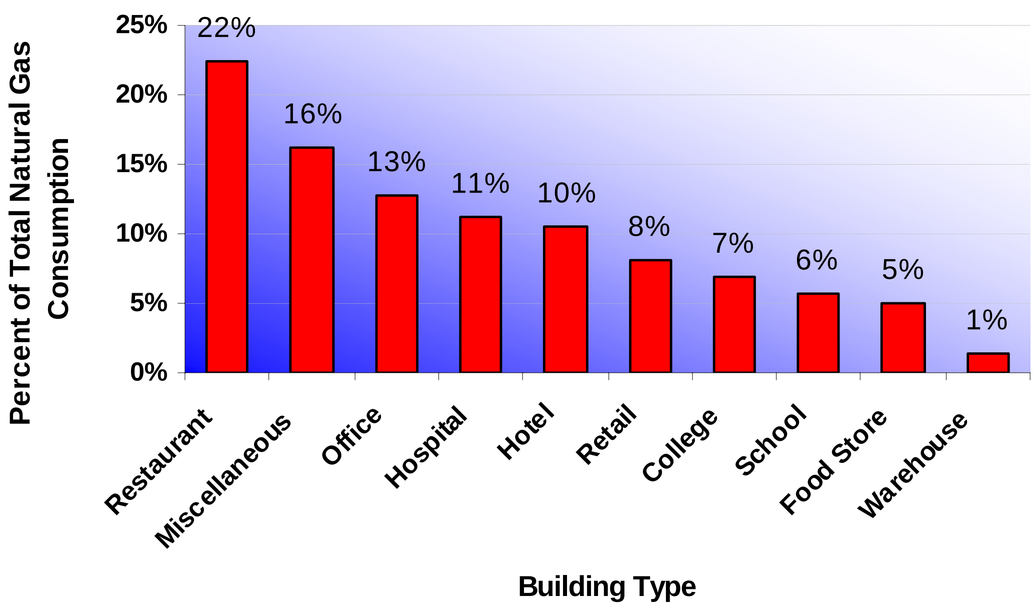
Least Cost-Effective

A detailed list and description of all commercial electric energy efficiency measures is found in Appendix F.

3.3 Commercial/Industrial/Agricultural Sector Natural Gas Use

The total annual energy consumption for the region's commercial/industrial/agricultural sectors in 2003 was 104.1 million therms at an estimated annual cost of $65 million[10]. This represents 51% of total natural gas consumption, compared to 61% for the state. The overall distribution of natural gas use in the commercial sector by building type is shown in Figure 6. This distribution indicates what building types would have the most gross natural gas energy efficiency savings potential- restaurants and offices. Commercial buildings include most public agency facilities.

Figure 6: Natural Gas Use in the Commercial Sector

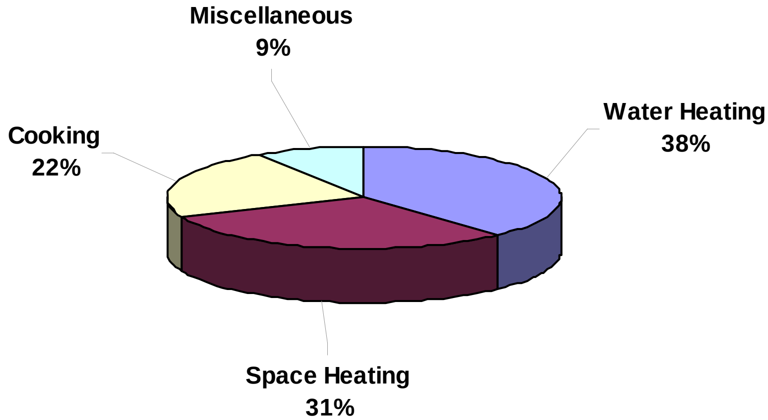


Source: CEC 2000. California Energy Demand: 2000-2010.

The distribution of commercial natural gas consumption by end use is shown in Figure 7.

[10] Assumes average natural gas rate of $0.65 per therm. Figures do not include natural gas supply to electric generation plants.

Figure 7: Commercial Natural Gas Consumption by End Use



3.3.1 Commercial Sector Energy Savings Potential

The total economic natural gas savings potential for PG&E and the derived proportion that represents the potential for the AMBAG region are shown in Table 7. The technical potential represents more than $11 million in annual cost savings to the region.

Table 7: Commercial Natural Gas Savings Potential for PG&E and the Region

Commercial Natural Gas Savings Potential (2002 through 2011)		
	Technical	Economic
PG&E (MM therms)	344	202
AMBAG Region (MM therms)	16	9

3.3.2 Commercial Sector: Natural Gas Energy Efficiency Measures

Table 8 lists the actual end-use measures that were evaluated as part of the commercial natural gas energy efficiency potential study. The measures are listed in order of cost-effectiveness (most cost-effective to least), and indicate the total potential savings per measure for the region, the levelized cost of the measure (dollars per kWh) and total potential cost savings for the region. The measures are grouped in terms of cost effectiveness, from most cost-effective to least. Investment in the marginal and least cost-effective measures could not be justified based on energy cost savings alone. This is not to say that one should not pursue measures that are marginally or least cost-effective. All of these measures should be pursued on equipment replacement. However, it is not as cost-effective as investing in other energy efficiency measures.

Table 8: Commercial Natural Gas Energy Efficiency Measures, AMBAG Region Potential Energy Savings, Levelized Energy Costs and Total Cost Savings By Measure

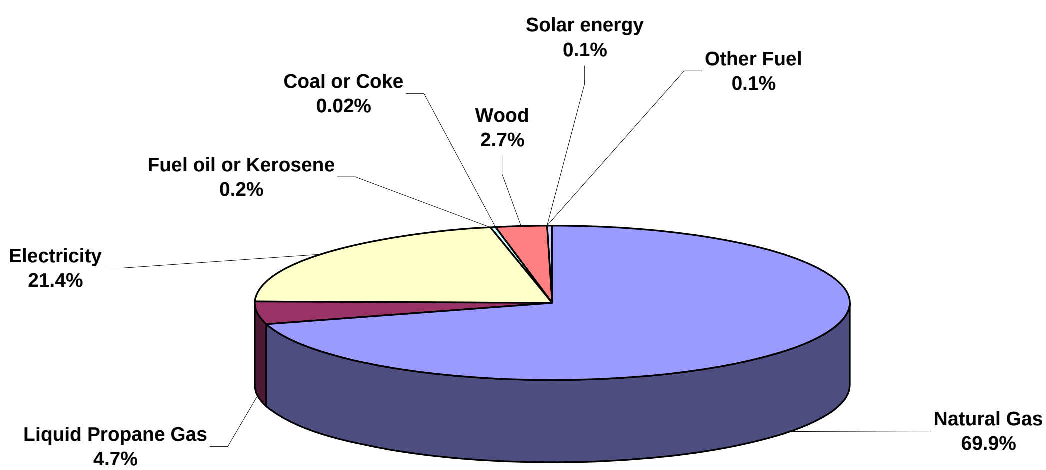
Measure	AMBAG Energy Savings (MMth)	Cost $/Therm	AMBAG Cost Savings ($ MM)	
Pool Cover	0.3	$ 0.03	$ 0.18	
Double-Pane Low-e Glass	2.0	$ 0.09	$ 1.30	Most Cost-Effective
Hot Water Heater Tank Insulation	1.2	$ 0.12	$ 0.78	
Faucet Aerator	0.2	$ 0.14	$ 0.13	
Circulation Pump Time Clocks	0.2	$ 0.16	$ 0.10	
Low Flow Showerheads	0.0	$ 0.17	$ 0.03	
Instant Hot Water Heater	0.2	$ 0.32	$ 0.13	
Infrared Fryer	2.4	$ 0.35	$ 1.59	
Pipe Insulation	0.2	$ 0.36	$ 0.10	
Duct Insulation-Installed	0.1	$ 0.36	$ 0.05	
High-Efficiency Gas Water Heater	3.9	$ 0.38	$ 2.52	
High-Efficiency Furnace/Boiler	4.1	$ 0.43	$ 2.68	
High-Efficiency Pool Heater	0.2	$ 0.48	$ 0.10	
Efficient Infrared Griddle	0.9	$ 0.60	$ 0.60	
Boiler Tune-Up	0.0	$ 0.60	$ 0.03	
Solar Demand Hot Water Heater	7.4	$ 0.77	$ 4.78	
Infrared Conveyor Oven	1.8	$ 1.29	$ 1.17	Marginally Cost-Effective
Solar Pool Heater	0.2	$ 1.50	$ 0.10	
Power Burner Fryer	0.5	$ 1.75	$ 0.34	
Energy Management System	1.2	$ 1.85	$ 0.81	
Convection Oven	0.7	$ 2.32	$ 0.47	Least Cost-Effective
Ceiling Insulation	0.2	$ 2.87	$ 0.16	
Energy Management System Optimization	0.2	$ 3.97	$ 0.10	
Boiler- Heating Pipe Insulation	0.0	$ 3.97	$ 0.03	
Power Burner Oven	0.5	$ 4.79	$ 0.31	
Heat Recovery: Air-to-Air	1.4	$ 9.80	$ 0.88	

A detailed list and description of all commercial natural gas energy efficiency measures is found in Appendix G.

3.4 Residential Sector

This plan addresses only electricity and natural gas use in the residential sector. Other fuels used in the residential sector (for heating) include liquid propane gas, fuel oil, kerosene, coal, wood and solar (See Figure 8).

Figure 8: Residential Fuel Use



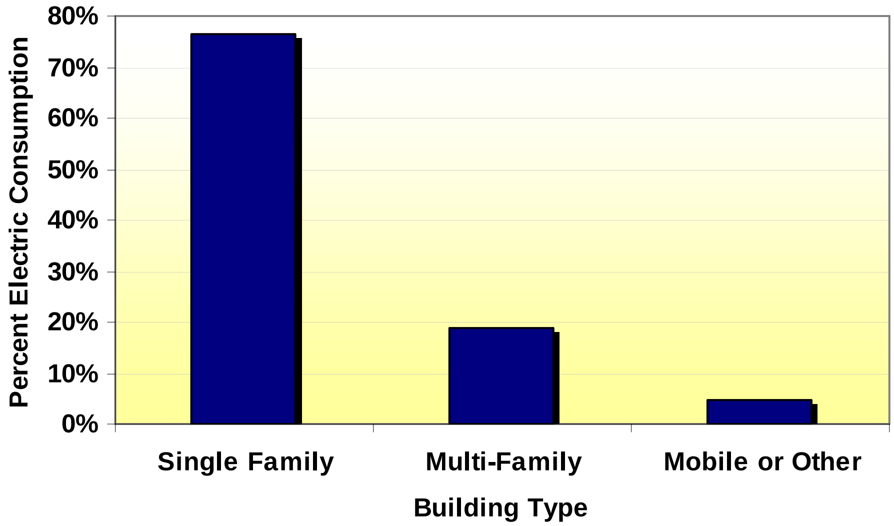
3.4.1 Residential Sector Electricity Use

The total annual electricity consumption for the residential sector in 2003 was 1,391 GWh. This represents an annual total energy cost of $191 million[11]. Residential electricity consumption for the region's residential sector is 33% of total consumption, compared to 34% for PG&E and 31% for the state. A typical household in the AMBAG region consumes 446 kWh in an average month, about 16% less than the average California home which consumes 534 kWh. This is primarily due to the moderate climate of the region and the reduced need for air-conditioning.

The overall statewide distribution of energy use in the residential sector by building type for the state shown in Figure 9.

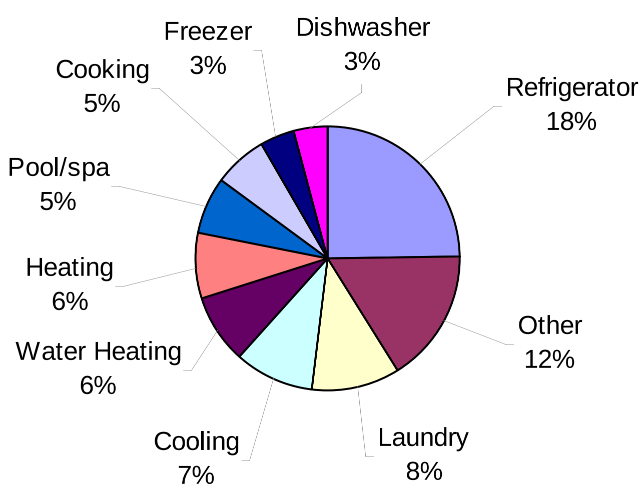
[11] Assumes average electricity rate of $0.137 per kilowatt-hour.

Figure 9: Residential Electric Use by Building Type



The residential end-use breakdown for the state is shown in Figure 10.

Figure 10: Residential End Use Breakdown



3.4.2 Residential Sector Electricity Energy and Demand Savings Potential

The total technical and economic electric energy and demand savings potential for PG&E and the region are shown in Table 9.

Table 9: Residential Electricity Energy Efficiency Potential

Residential Electricity Savings Potential (2002 through 2011)		
	Technical	**Economic**
PG&E (GWh)	8,883	6,839
AMBAG Region (GWh)	497	383

Residential Electricity Demand Savings Potential (2002 through 2011)		
	Technical	**Economic**
PG&E (MW)	2,324	1,508
AMBAG Region (MW)	130	84

3.4.3 Residential Sector: Energy Efficiency Measures

Table 10 lists the actual end-use measures that were evaluated as part of the residential electricity energy efficiency potential study. The measures are listed in order of cost-effectiveness (most cost-effective to least) and indicate the total potential savings per measure for the region, the levelized cost of the measure (dollars per kWh) and total potential cost savings for the region. The measures are grouped in terms of cost effectiveness, from most cost-effective to least. Investment in the marginal and least cost-effective measures could not be justified based on energy cost savings alone. This is not to say that one should not pursue measures that are marginally or least cost-effective. All of these measures should be pursued on equipment replacement. However, it is not as cost-effective as investing in other energy efficiency measures.

Table 10: Residential Electricity Energy Efficiency Measures, AMBAG Region Potential Energy Savings, Levelized Energy Costs and Total Cost Savings By Measure

Measure	AMBAG Energy Savings (GWh)	Levelized Energy Costs ($/kWh)	AMBAG Cost Savings ($ MM)
Water Heater Blanket	6	$ 0.008	$ 1.0
Pipe Wrap	1	$ 0.016	$ 0.2
High Efficiency Tube Fluorescent	17	$ 0.017	$ 2.5
Double Pane Window	50	$ 0.023	$ 7.5
Low Flow Showerhead	2	$ 0.026	$ 0.3
High-Efficiency Pool Pump and Motor	59	$ 0.029	$ 8.8
Faucet Aerators	1	$ 0.031	$ 0.2
Compact Fluorescent Lamps	333	$ 0.036	$ 49.9
High-Efficiency Clothes Washer	33	$ 0.043	$ 5.0
High-Efficiency Water Heater	5	$ 0.057	$ 0.7
High-Efficiency Freezer	9	$ 0.064	$ 1.4
Refrigerator- Early Replacement	220	$ 0.065	$ 33.0
Heat Pump Space Heater	21	$ 0.085	$ 3.2
Energy Star Dishwasher	10	$ 0.086	$ 1.5
Duct Insulation	1	$ 0.109	$ 0.2
High-Efficiency Refrigerator	55	$ 0.120	$ 8.2
Thermal Expansion Valve-A/C	6	$ 0.124	$ 1.0
Heat Pump Water Heater	32	$ 0.143	$ 4.8
High-Efficiency Clothes Dryer	9	$ 0.178	$ 1.3
Wall Insulation	11	$ 0.205	$ 1.6
Ceiling Insulation	14	$ 0.215	$ 2.1
Programmable Thermostat	3	$ 0.240	$ 0.4
HVAC Testing and Repair	9	$ 0.241	$ 1.3
Duct Repair	4	$ 0.263	$ 0.7
Floor Insulation	1	$ 0.477	$ 0.2
High-Efficiency Room Air-Conditioner	2	$ 0.529	$ 0.3
Window with Sunscreen	21	$ 0.600	$ 3.2
Solar Water Heater	13	$ 0.647	$ 2.0
Direct Evaporative Cooler	10	$ 0.652	$ 1.5
Whole House Fans	11	$ 0.679	$ 1.6
Attic Venting	3	$ 0.789	$ 0.5
Central Air-Conditioner	24	$ 1.095	$ 3.6
Infiltration Reduction	1	$ 2.049	$ 0.1
Ceiling Fans	1	$ 2.454	$ 0.1
Cool Roofs	5	$ 16.810	$ 0.8

Most Cost-Effective

Marginally Cost-Effective

Least Cost-Effective

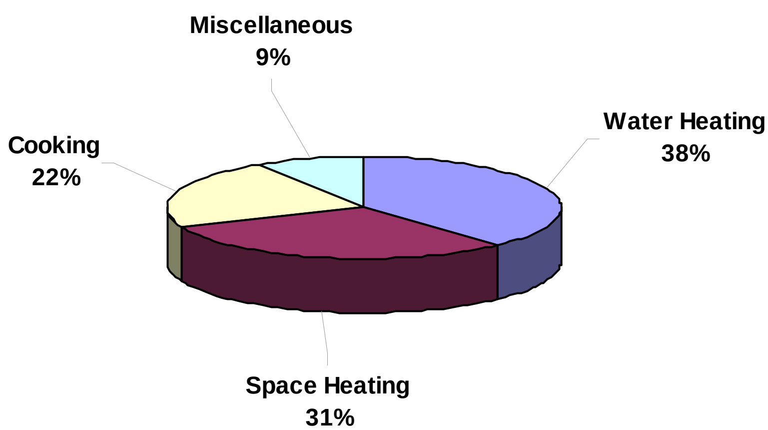
It should be noted that some measures were not evaluated, and therefore are not listed. Some of these measures include shade trees and new construction and planning techniques, such as building orientation.

A detailed list and description of all residential electric energy efficiency measures is found in Appendix H.

3.4.4 Residential Sector Natural Gas Use

The total annual energy consumption for the region's residential sector in 2003 was 99.8 million therms at an estimated annual cost of $100 million[12]. This represents 49% of total natural gas consumption for the region, compared to 37% for the state and 47% for PG&E. The residential natural gas consumption by end-use is shown in Figure 11.

Figure 11: Residential Natural Gas Consumption by End Use



3.4.5 Residential Sector Energy Savings Potential

The total economic natural gas savings potential for PG&E and the derived proportion that represents the potential for the AMBAG region are shown in Table 11. The technical potential represents more than $11 million in annual cost savings to the region.

Table 11: Residential Natural Gas Savings Potential for PG&E and the Region

Commercial Natural Gas Savings Potential (2002 through 2011)		
	Technical	Economic
PG&E (MM therms)	344	202
AMBAG Region (MM therms)	16	9

[12] Assumes average natural gas rate of $1.00 per therm. Figures do not include natural gas supply to electric generation plants.

3.4.6 Residential Sector: Natural Gas Energy Efficiency Measures

Table 12 lists the actual end-use measures that were evaluated as part of the residential natural gas energy efficiency potential study. The measures are listed in order of cost-effectiveness (most cost-effective to least), and indicate the total potential savings per measure for the region, the levelized cost of the measure (dollars per kWh) and total potential cost savings for the region. The measures are grouped in terms of cost effectiveness, from most cost-effective to least. Investment in the marginal and least cost-effective measures could not be justified based on energy cost savings alone. This is not to say that one should not pursue measures that are marginally or least cost-effective. All of these measures should be pursued on equipment replacement. However, it is not as cost-effective as investing in other energy efficiency measures.

Table 12: Residential Natural Gas Energy Efficiency Measures, AMBAG Region Potential Energy Savings, Levelized Energy Costs and Total Cost Savings By Measure

Measure	AMBAG Energy Savings (MMth)	Cost $/Therm	AMBAG Cost Savings ($ MM)
Water Heater Blanket	4.2	$ 0.080	$ 4.2
Pipe Wrap	0.8	$ 0.170	$ 0.8
Low-Flow Showerhead	1.56	$ 0.290	$ 1.6
Faucet Aerators	0.96	$ 0.340	$ 1.0
Boiler Controls	0.32	$ 0.400	$ 0.3
Duct Insulation	0.48	$ 0.590	$ 0.5
Programmable Thermostat	0.6	$ 0.600	$ 0.6
HVAC Testing and Repair	2.4	$ 0.780	$ 2.4
High-Efficiency Boiler	0.24	$ 0.820	$ 0.2
High-Efficiency Water Heater	3.04	$ 0.930	$ 3.0
Horizontal Access Clothes Wash	12.88	$ 0.930	$ 12.9
Wall Insulation	6.08	$ 0.980	$ 6.1
Ceiling Insulation	3.36	$ 1.070	$ 3.4
Duct Repair	1.6	$ 1.700	$ 1.6
Energy Star Dishwasher	3.16	$ 1.990	$ 3.2
Condensing Furnace	7.72	$ 2.820	$ 7.7
Floor Insulation	2.84	$ 3.110	$ 2.8
Solar Water Heat	33.24	$ 3.520	$ 33.2
Infiltration Reduction	0.24	$ 5.060	$ 0.2
High-Efficiency Clothes Dryer	0.2	$ 6.430	$ 0.2

Most Cost-Effective

Marginally Cost-Effective

Least Cost-Effective

A detailed list and description of all residential natural gas energy efficiency measures is found in Appendix I.

4 Electricity Generation: Conventional Grid-Based, Distributed and Renewables

Grid-based, centralized electric power plants tied to the high-voltage transmission grid are expected to continue to be the major power supply source for the state and the region for the foreseeable future. The California Energy Action Plan places an increased emphasis on the use of renewable resources and clean, efficient distributed generation (DG) technologies. Many of these technologies are beginning to complement central power plants by providing cost-effective incremental capacity to the utility grid or to an end user.

This chapter addresses two general categories of generation in terms of fuel sources, including renewables and convention fossil-fuel (including nuclear). In addition, we will categorize by size and location, as follows: large, grid-based, and distributed (small-scale power generation technologies located close to where electricity is used. This distinction is important, since each have different attributes and economic considerations. Grid-based renewables (e.g. a large wind farm) are generally larger renewable systems that are connected to the electricity grid at a substation on the distribution or transmission system, and then sold to utility customers as part of the overall mix of utility-procured resources. The electricity generated must pass through the transmission and distribution system and is subject to efficiency losses and possible transmission constraints in the system. The costs of these renewables must generally compete with other wholesale, grid-based generation alternatives, like conventional natural gas combined-cycle plants, nuclear power plants, coal power plants and large hydro (usually between $0.04 and $0.07 per kWh).

Distributed generation is located at or near the load they serve and is not constrained by the grid system, thereby avoiding any losses in transporting the electricity through the transmission and distribution system. Additionally, the economics of distributed generation is generally driven by retail costs of electricity that are paid by the respective customer. This can range from as low as $0.10 per kWh to as high as $0.19 per kWh.

For distributed generation and renewables, only grid-tied, customer-based generation that serves customer load is considered. Off-grid systems are not considered because they serve a load that is not tracked by any publicly-available data base. In addition, data for customer-based generation that is sold to a utility is not readily available. Backup generators are also not considered since they generally do not provide electricity that would offset electricity resources. However, back-up generation could be significant since it could be converted to distributed generation, or used on an emergency basis during critical peak periods to prevent widespread blackouts (as was done during the summer of 2001).

This Chapter will address electricity production in the following order:

1. Conventional, Grid-Based Systems (Non-Renewable)

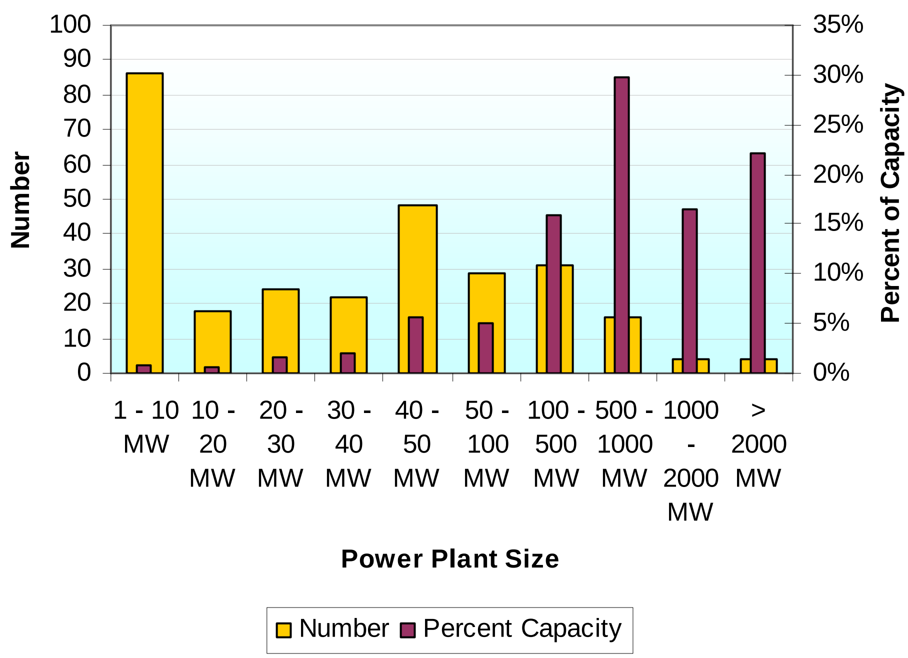
2. Distributed Generation

3. Renewables

4.1 Conventional Generation

Most larger, conventional, grid-based generation in the State of California are either simple or combined-cycle, natural gas, oil-fueled plants, or nuclear (e.g. Diablo Canyon and San Onofre). Over 42% of these power plants (approximately 15,400 MW) throughout California were built before 1965 and are reaching the end of their useful, economic life. As is shown in Figure 12, a larger number (80%) of power plants are small (less than 100 MW), however, most of the capacity (84%) comes from plants larger than 100 MW.

Figure 12: California Grid-Based Power Plants by Size and Quantity

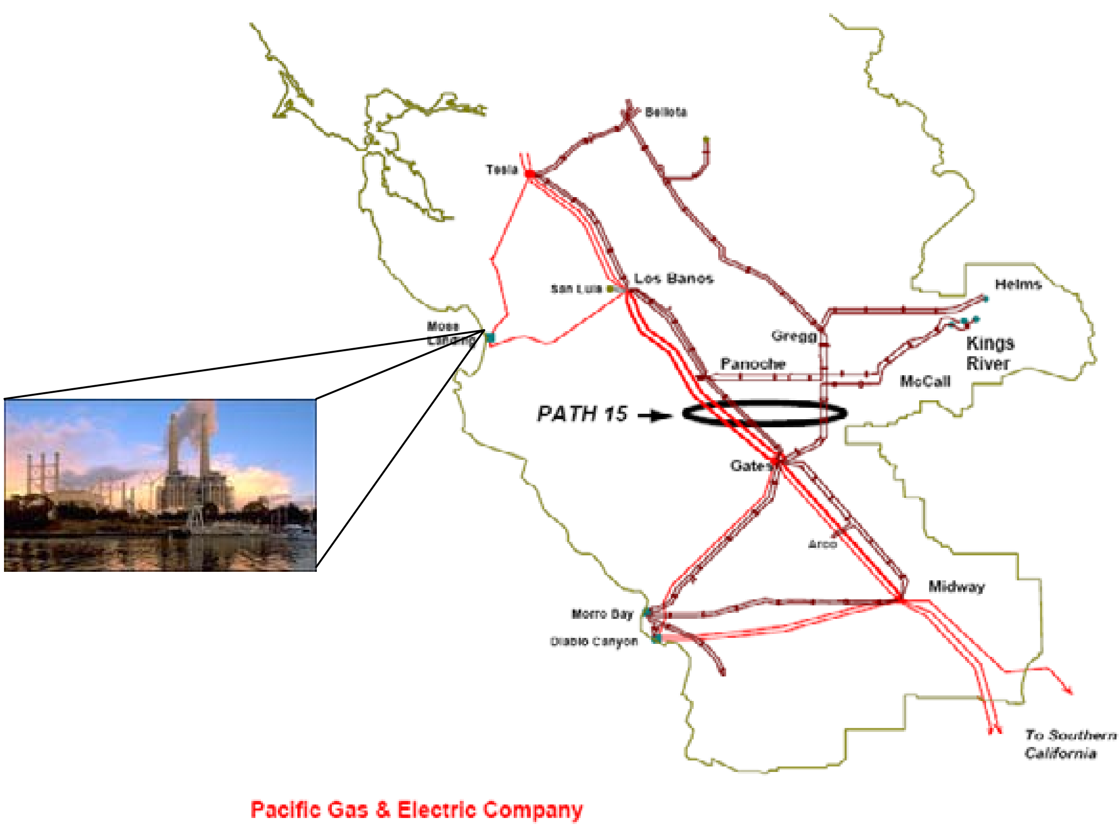


The Monterey Bay Region is a host for several electric generation plants (See Table 13). These generation plants represent about 11% of PG&E's generation and about 6% of the state's demand. Many smaller power plants that are located at customer sites and are designed to serve the load at the host facility are not listed (data was not available).

Table 13: Electricity Generation Plants in the AMBAG Region

POWER PLANT NAME	CAPACITY (MW)	PRIMARY FUEL	COUNTY
MOSS LANDING	2570.0	NATURAL GAS	MONTEREY
CALPINE KING CITY COGEN	130.0	NATURAL GAS	MONTEREY
CALPINE KING ENERGY CENTER	50.0	NATURAL GAS	MONTEREY
SALINAS RIVER COGEN	49.6	NATURAL GAS	MONTEREY
SARGENT CANYON COGEN	38.0	NATURAL GAS	MONTEREY
MONTEREY POWER CO.	6.0	NATURAL GAS	MONTEREY
MARINA LANDFILL GAS	5.4	MSW	MONTEREY
NACIMIENTO HYDROELECTRIC	4.4	HYDRO	MONTEREY
SOLEDAD STATE PRISON	2.2	NATURAL GAS	MONTEREY
MONTEREY REGIONAL WATER POLLUTION C	1.7	MSW	MONTEREY
SALINAS	1.4	MSW	MONTEREY
ASILOMAR	0.6	NATURAL GAS	MONTEREY
WATSONVILLE COGEN	31.0	NATURAL GAS	SANTA CRUZ
SANTA CRUZ COGEN	2.6	NATURAL GAS	SANTA CRUZ
CITY OF SANTA CRUZ WASTEWATER	0.8	MSW/ NAT GAS	SANTA CRUZ
OWL COMPANIES	0.6	NATURAL GAS	SANTA CRUZ
UC SANTA CRUZ SPORTS FACILITY	0.3	NATURAL GAS	SANTA CRUZ
WATER STREET JAIL	0.2	NATURAL GAS	SANTA CRUZ

Figure 13: Moss Landing Power Plant and Transmission Infrastructure in the AMBAG Region



4.2 Distributed Generation Overview

The California Energy Commission (CEC) defines distributed generation (DG) as “small-scale power generation technologies (typically in the range of 3 to 10,000 kW) located close to where electricity is used (e.g., a home or business) to provide an alternative or an enhancement of the traditional electric power system.” Alternatively, DG could be located on a utility's distribution system for the purpose of meeting local peak loads and/or displacing the need to build additional local distribution lines.

DG provides significant benefit to utilities and ratepayers by avoiding or reducing the cost of transmission and distribution system improvements, avoiding congestion problems, adding voltage support, providing more efficient use of natural gas (through CHP), reducing peaking and base load generation development requirements and providing additional generation without the capital cost being passed on to consumers. The individual customer could benefit from increased reliability, reduced peak demand and the ability to choose a power supply in the absence of direct access. Broader regional benefits from DG include: power supply diversity, increased in-region power supply, DG as a hedge against high grid-based power supply options, and energy security through enhanced “control” of supply and economic development.

Several economic, regulatory and institutional barriers exist that will influence the rate at which DG penetrates the Monterey Bay region. Perhaps the most significant barrier to widespread deployment of DG is the high up-front capital cost of many technologies. While some DG technologies are relatively cost effective (e.g., CHP, biogas), others currently depend on government incentives (e.g. solar PV, wind and geothermal). Regulatory barriers include tariff configuration, costly system exit fees and permitting processes, standby changes, predictable and reasonable prices for all of electricity sold to the grid and better scheduling arrangements for excess power.

The extent to which DG contributes to the region’s energy future depends largely on the cost of energy, technological advances, the degree to which environmental externalities are valued (e.g., impact of emissions) and removal of critical barriers through regulatory and/or legislative decisions.

4.2.1 Distributed Generation Technologies

Reciprocating Engines

Reciprocating engines are the most common and most technically mature of all DG technologies. They are available from small sizes (e.g., 5 kW for residential back-up generation) to large generators (e.g., 7 MW). Reciprocating engines use commonly available fuels such as gasoline, natural gas, and diesel fuel. Efficiencies of reciprocating engines range from 25 to 45%.

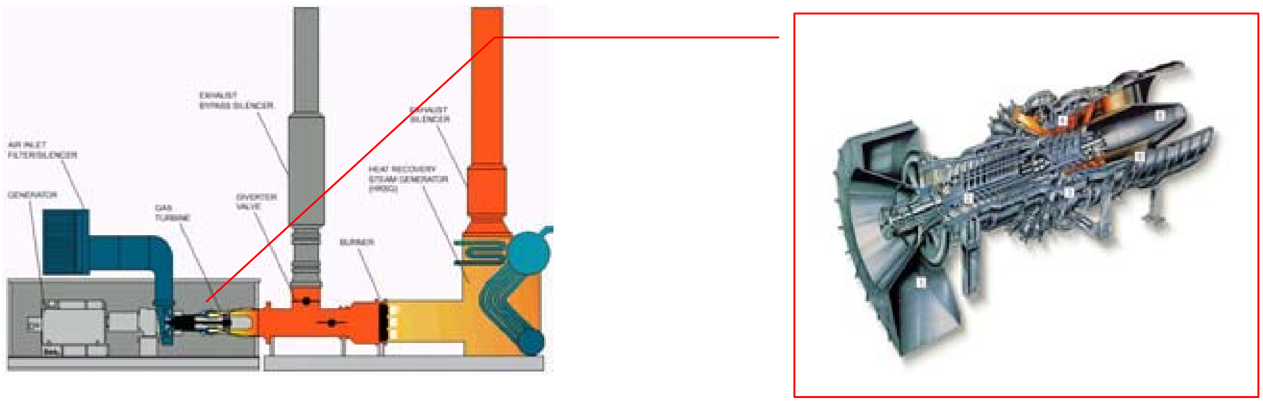
Figure 14: Reciprocating engine (Photo Source: Caterpillar).

A reciprocating, or internal combustion (IC), engine converts the energy contained in a fuel into mechanical power. This mechanical power is used to turn a shaft in the engine. A generator is attached to the IC engine to convert the rotational motion into power.

Combustion Turbine (CT)

Conventional combustion turbine (CT) generators are a very mature technology. They typically range in size from about 500 kW up to 25 MW for DG applications and up to approximately 250 MW for central power generation. They are fueled by natural gas, oil, or a combination of fuels. Modern single-cycle combustion turbine units typically have efficiencies in the range of 20 to 45% at full load (Figure 15).

Figure 15: Cutaway of a Combustion Turbine



Microturbines

Microturbines are small combustion turbines that produce between 25 kW and 500 kW of power. Microturbines were derived from turbocharger technologies found in large trucks or the turbines in aircraft auxiliary power units (APUs). Most microturbines are single-stage, radial flow devices with high rotating speeds of 90,000 to 120,000 revolutions per minute (Figure 16).

Figure 16: A Bank of Microturbines Powering a Commercial Customer in a Combined Heat and Power Configuration

Combined Heat and Power Plants (CHP)

The average power plant loses more than two-thirds of the energy content of the input fuel in the form of heat. CHP systems capture and use that heat to generate both thermal and electrical energy. "CHP," also called cogeneration, can significantly increase the efficiency of energy utilization; reduce emissions of criteria pollutants and CO_2, and lower operating costs for industrial, commercial and institutional users."[13]

[13] Market Assessment of Combined Heat and Power in the State of California, California Energy Commission. December 1999.

Fuel Cells[14]

Fuel cells operate very similar to batteries in that they use an electrochemical process to generate power rather than burning fossil fuels. The primary difference is that a fuel cell does not discharge, as long as the fuel continues to be fed into the system. A fuel cell consists of two electrodes sandwiched around an electrolyte. Oxygen passes over one electrode and hydrogen over the other, generating electricity, water and heat.

A fuel cell system which includes a "fuel reformer" can utilize the hydrogen from any hydrocarbon fuel including natural gas, methanol and gasoline. Since the fuel cell relies on chemistry and not combustion, emissions from this type of a system would still be much smaller than emissions from the cleanest fuel combustion processes.

At least two fuel cells are operational in California, with another 6 under development (a total of approximately 6 MW).

Figure 17: A 250 kW Fuel Cell for Commercial and Industrial Applications (left), and a 5 kW Fuel Cell for Residential Applications (right)

The most common fuel cells today are about 250 kW in size, suitable for commercial applications. Larger fuels cells are under development, as well as smaller versions (about 5 kW) that are intended to power homes (See Figure 17).

Fuel cells hold long-term promise of generating electricity efficiently with minimal pollution. At over $9,000 per kilowatt (installed), fuel cells are being used only in niche markets at this time.

Stirling Engines

Stirling engines are classed as external combustion engines. They are sealed systems with an inert working fluid, usually either helium or hydrogen. They are generally found in small sizes (1 - 25 kW) and are currently being produced in small quantities for specialized applications.

[14] Portions of this section adapted from Fuels Cells 2000 [http://www.fuelcells.org/] and U.S. EPA [www.epa.gov/otaq/ fuelcell/basicinfo.htm].

Stirling-cycle engines were patented in 1816 and were commonly used prior to World War I. They were popular because they had a better safety record than steam engines and used air as the working fluid. As steam engines improved and the competing compact Otto cycle engine was invented, Stirling engines lost favor. Recent interest in DER, use by the space and marine industries, has revived interest in Stirling engines and as a result, research and development efforts have increased.

Energy Storage

Energy storage technologies do not generate electricity but can deliver stored electricity to the electric grid or an end-user. They are used to improve power quality by correcting voltage sags, flicker, and surges, or correct for frequency imbalances. Storage devices are also used as uninterruptible power supplies (UPS) by supplying electricity during short utility outages. Because these energy devices are often located at or near the point of use, they are included in the distributed energy resources category. Storage technologies include batteries, flywheels, superconducting magnetic storage, compressed air and super capacitors.

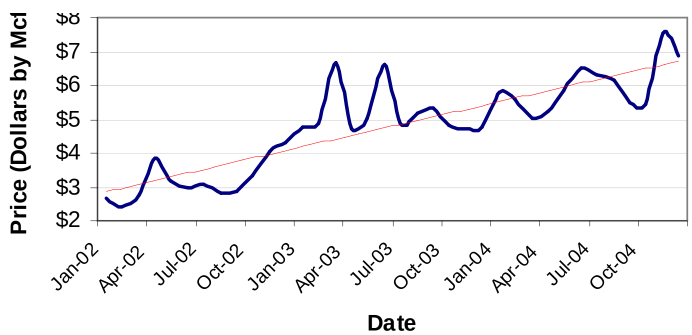
4.3 Renewables[15]

Renewable energy is an important priority in the state's electricity resource mix. Renewables are considered resources that are replenishable. They include biomass, solar thermal, wind, geothermal, small hydroelectric power less than 30 megawatts (MW), digester gas, landfill gas, municipal solid waste, ocean wave, ocean thermal, and tidal current.

The benefits or renewable resources are significant, including:

- Increased diversity of fuel sources and reduced dependence on natural gas-fueled generation[16].
- Mitigation of fuel-price risk. For electricity generated from renewable resources that is sold under long-term contracts, it is generally immune to the extreme volatility of natural gas prices (see Figure 18).
- Reduced emissions of pollutants such as nitrogen oxides[17], sulfur

Figure 18: Natural Gas Prices (January 2002 through March 2004)



[15] This section draws extensively from the CEC Renewable Resources Development Report, November 2003.

[16] Most new electric generation is expected to be fueled by natural gas and generation makes up most, if not nearly all future natural gas load growth. This large growth in demand, coupled with dwindling domestic supply, continue to drive prices to all time highs. This demand is also driving the state's policy to support the construction of complex, expensive, liquefied natural gas (LNG) terminals. These terminals would import LNG from countries such as Bolivia, Algeria, Nigeria, Trinidad, Indonesia, Malaysia, Australia, Oman and the UAE. Some consider this policy risky as it increases our dependence on foreign, potentially unstable sources.

[17] NOx emissions are a factor in ground-level ozone formation, acid rain, eutrophication of terrestrial and aqueous ecosystems, depletion of stratospheric ozone, and climate change. NOx is also associated with a wide range of

dioxide and carbon dioxide (CO_2) as a result of electricity production[18].

In addition to an aggressive pursuit of energy efficiency and demand response, the State has instituted more ambitious renewable energy goals to meet critical state policy goals. The current Renewable Portfolio Standard (SB 1078) requires utilities to achieve 20 percent of their supply from renewable sources by 2017.

On October 20, 2004, Governor Schwarzenegger announced his policy to promote the installation of solar technologies in California homes and commercial buildings as an environmentally sound way of meeting California's future energy needs. Specifically, the Governor proposed the following: the installation of one million solar roofs, or 3,000 MW by 2017 on new and existing homes and businesses; the inclusion of solar thermal systems, to offset the increasing demand for natural gas; the inclusion of advanced metering in solar applications; and the creation of a funding source which can provide rebates over ten years through a declining incentive schedule.

A cornerstone of the state's commitment to renewables is the Renewable Portfolio Standard (RPS)[19] that requires all investor-owned utilities (IOUs) to increase their portfolio of renewable resources by at least one percent of sales every year to reach the target of 20 percent renewable resources by 2017[20]. The *California Energy Action Plan* and subsequent pending legislation accelerated the 20 percent target to 2010. Large hydro does not count toward the state-managed RPS.

Different generation operational modes will range from base load, to intermediate, to a peaking type of facility. A base load facility generally delivers power at a constant rate whenever the plant is available. A facility may also be used to provide spinning reserve to deliver power during intermittent emergencies on extremely short notice. In between these modes of operation are intermediate/load-following facilities, where a plant follows the daily cycles in load. A peaking facility is called upon only during the highest daily loads during the seasonal peaks. Some facilities may provide ancillary services, where a plant provides system support, such as voltage regulation. An intermittent/variable facility may deliver power whenever the driving resource, such as wind, is available.

Table 14 presents the costs of various generation technologies in terms of levelized costs. Levelized costs can be interpreted as a constant level of revenue necessary each year to recover all expenses over the expected economic life of the project, assuming all costs are known. Levelized costs for any power plant are a function of all the fixed and varying annual costs (e.g., financing, operations and maintenance, and fuel).

---

public health problems, including breathing problems, asthma, and reduced resistance to colds and other infections.

[18] Increasing CO_2 levels are a primary cause of global climate change, which is linked to higher ambient temperatures, increases in extreme weather events, rising sea levels, and other global problems. Effects on California may include reduced Sierra snow pack, greater flooding, sea water intrusion in bays and deltas, and increased susceptibility of pests and diseases impacting human health and our biological resources. The Energy Commission estimates that meeting the Renewables Portfolio Standard requirements could reduce annual carbon dioxide emissions by 38 million tons in the Western Electricity Coordinating Council by 2013, with annual reductions of 62 million tons by 2013 if the Renewables Portfolio Standard is accelerated.

[19] Originally specified in SB 1078, codified in Chapters 516, Statutes of 2002, Sher.

[20] For PG&E, 20% of sales is equal to 17,880 GWh in 2017, and 16,150 GWh in 2010.

Table 14: Levelized Costs of Various Generation Technologies (Source: CEC Comparative Costs of Central Station Electricity Generation Technologies, June 2003).

Technology Energy Source	Fuel	Economic Life	Gross Capacity (MW)	Direct Cost-Levelized (cents per kWh)
Landfill Gas	Methane	30	4	4.40
Geothermal: Flash	Water	30	50	4.52
Wind	Wind	30	100	4.93
Combined Cycle	Natural Gas	20	500	5.18
Hydropower	Water	30	100	6.04
Biomass: Solid	Biomass	30	20	6.60
Geothermal: Binary	Water	30	35	7.37
Fuel Cell- Hybrid	Natural Gas/ Landfill or Waste Gas	20	25	9.41
Fuel Cell- Molten Carbonate	Natural Gas/ Landfill or Waste Gas	20	25	10.15
Fuel Cell- Solid Oxide	Natural Gas/ Landfill or Waste Gas	20	25	13.04
Solar Thermal Parabolic Trough- Gas	Sun/ Natural Gas	30	110	13.52
Solar Thermal- Stirling Dish	Sun	30	31.5	15.37
Simple Cycle	Natural Gas	20	100	15.71
Solar Thermal Parabolic Trough- TES	Sun	30	110	17.36
Fuel Cell- Phosphoric Acid	Natural Gas/ Landfill or Waste Gas	20	25	21.27
Solar Thermal Parabolic Trough	Sun	30	110	21.53
Photovoltaic	Sun	30	0.25	27.50

<u>Key</u>
BL = Baseload
PK = Peaking
LF = Load Folowing
RL = Resource Limited

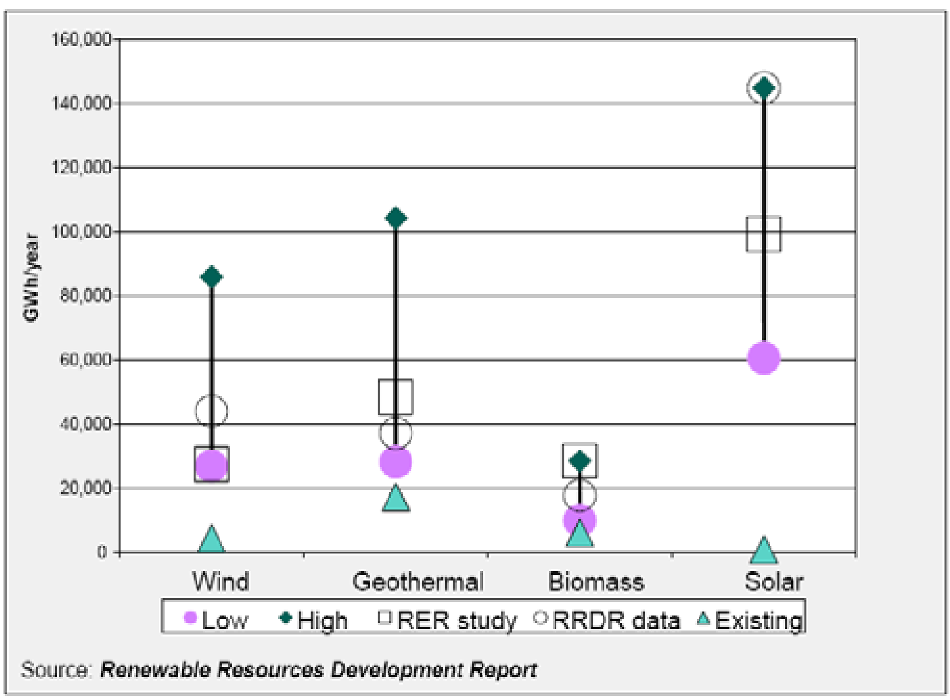
Comparing technologies on levelized cost alone is not appropriate, considering that different technologies provide different services. For example, wind is very competitive on the basis of cost per kWh, but it can only provide variable output. Other renewable resources, such as geothermal, have much more predictable output that may be more valuable to maintain system reliability. The installed, first-cost of renewables is also generally higher than that of conventional fossil-fueled generation.

Despite its support of renewable energy, California depends increasingly on natural gas generation. Natural gas-fired generation in California is expected to increase from 36% in 2004 to 43% in 2013. During this same timeframe, more than half of all growth in natural gas use is due to the growth in electric generation demand. Reductions in available hydroelectricity will push this percentage even higher. Much of this future demand will be met by liquefied natural gas (LNG). The rate and degree to which the state deploys renewable resources will have a significant impact on the need for LNG[21]. According to the CEC, the state would need to achieve a level of renewables of 38% of retail sales by 2017 to offset growth in natural gas generation.

The estimated combined technical potential for wind, geothermal, biomass, biogas, small hydroelectric, and solar (photovoltaic and concentrated solar power) in California is more than 262,000 GWh/year[22]. This is roughly equal to the total consumption of the state in 2002.

The potential for renewables by technology compared to the current resources is illustrated in Figure 19.

Figure 19: Renewables Technical Potential in California by Technology (Source: CEC Renewable Resources Development Report)



[21] CEC 2003 IEPR.

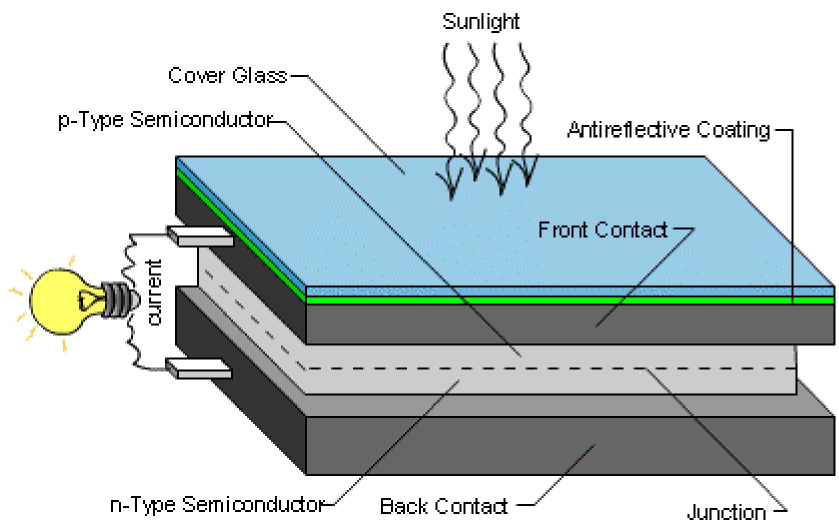
[22] CEC Renewable Resources Development Report, November 2003.

4.3.1 Solar Photovoltaics

Photovoltaic (PV) cells, or solar cells, convert sunlight directly into electricity. PV cells are assembled into flat plate systems that can be mounted on rooftops, parking garages or other sunny areas. They generate electricity with no moving parts, operate quietly with no emissions and require little maintenance. The costs of PV are higher than that of convention grid-based generation, but PV can be cost–effective in certain applications. Efficiencies of solar PV range from 10 to 14%.

A photovoltaic cell is composed of several layers of different materials. The top layer is a glass cover to protect the cell from weather conditions. This is followed by an anti-reflective layer to prevent the cell from reflecting the light away (Figure 20). Two semiconductor layers, usually made of silicon, cell create the electron current. Metallic grids collect electrons from the semiconductors and transfer them to the external load.

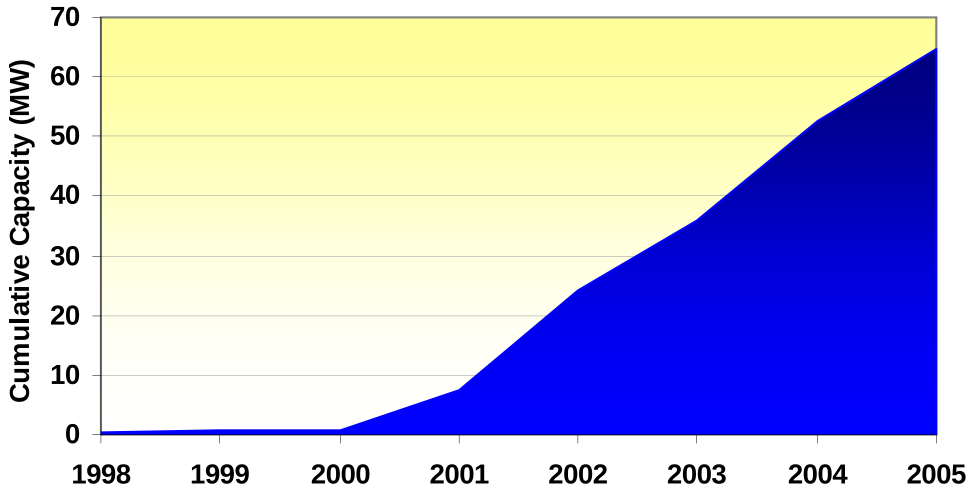
Figure 20: The Structure of a Solar Cell



Since the late 1990s, the worldwide and U.S. solar photovoltaic (PV) market has been growing at between 20 to 25% per year. In 2002, world production of PV panels grew by 43.8 percent. Several events contributed to this rapid market growth, including the success of the PV programs in Japan and Germany, U.S. federal and state tax credits, RPS requirements and incentive programs.

PV in California and the region has been growing at a much more significant rate, largely due to government incentives and the large increases in electricity prices in 2001. Across the state, there was a total of about 7.7 MW installed prior to 2000. From 2000 to 2004, there was nearly 52 MW installed, with an additional 64 MW of projects under development in 2005. The total capacity of solar PV at the end of 2005 will be equal to that of a small conventional, grid-based power plant. The growth of California PV capacity in the last 6 years is shown in Figure 21.

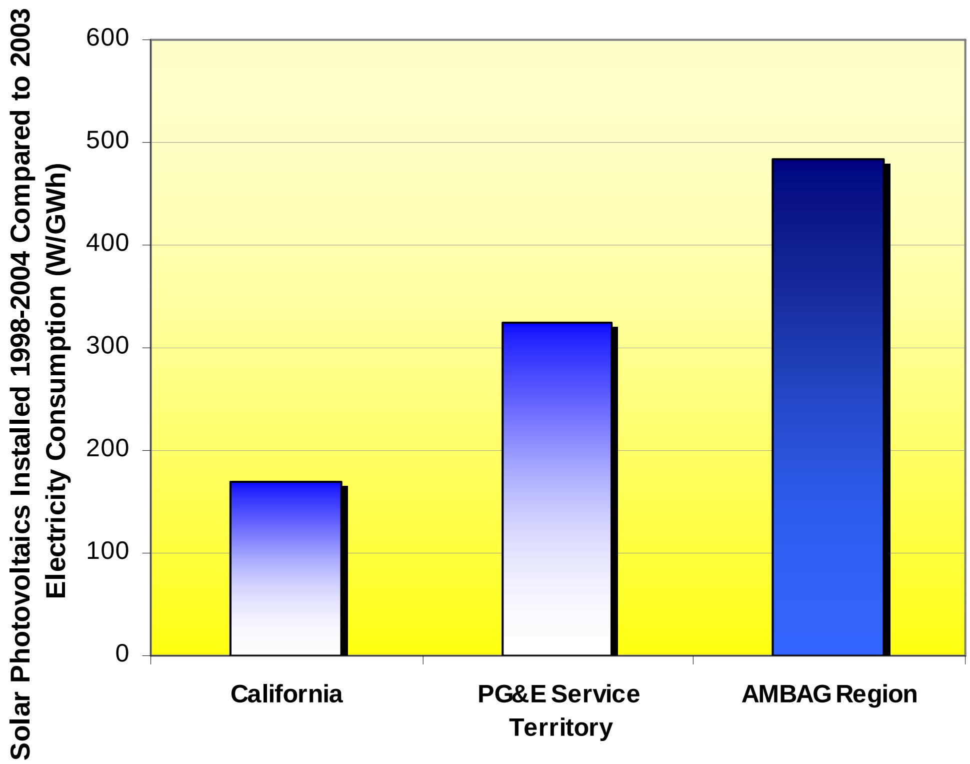
Figure 21: The Cumulative Capacity of Solar PV Installed in California from 2000 to 2004 (Data Source: CEC)



Currently, the region has approximately 14 MW of renewable energy generation capacity, including solar, wind, municipal wastewater digester gas, landfill and solar. It is particularly noteworthy that the growth in PV in the AMBAG region has far exceeded the growth in PV for the rest of the State of California on a proportional basis. While the state has seen an increase of nearly a factor of 10, the region's solar capacity has increased by over 29 times, with over 650 new systems with a total capacity of 2.1 MW (not including Self-Generation Program). This represents nearly three times the solar that was installed statewide, and 1.5 times the solar installed in the PG&E service territory on a proportional basis).

The growth in PV in the AMBAG region has far exceeded the growth in PV for the rest of the State of California. While the state has seen an increase of nearly a factor of 10, the region's solar capacity has increased by over 29 times, with over 650 new systems with a total capacity of 2.1 MW (not including Self-Generation Program). As shown in Figure 22, on a proportionate basis, the AMBAG region has installed nearly three times the solar that was installed statewide, and 1.5 times the solar installed in the PG&E service territory.

Figure 22: The Capacity of Solar PV for the AMBAG Region Significantly Exceeds that of the State and the PG&E Service Territory on a Proportional Basis



Two statewide programs provide financial incentives for PV systems installed in PG&E, SCE, and SDG&E service territories. The Emerging Renewables Program, administered by the California Energy Commission, provides rebates for systems 30 kW or smaller. PG&E, SCE, Southern California Gas and the San Diego Regional Energy Office administer the Self-Generation Incentive Program, which supports distributed generation systems larger than 30 kW.

One of the more significant solar projects in the region is the Vista Montana housing complex in Watsonville. The development has 257 solar-powered, single-family homes and town homes (Figure 23).

Figure 23: The Vista Montana Housing Development in Watsonville, CA. Source: Santa Cruz Sentinel.

4.3.2 Potential for Photovoltaics in the Monterey Bay Region

Photovoltaics could play a significant role in regional energy resources. According to the CEC, the potential for solar PV is 198 MW and 260 GWh per year[23] (currently, the region has 2.1 MW that produce an estimated 2.8 GWh per year).

Among the most promising markets for photovoltaics include large commercial and industrial (C&I) customers, new home construction and public agencies. The C&I segment is attractive because multiple government incentives make systems cost-effective. Simple paybacks of 5 to 8 years are not uncommon. The new home construction market also can be cost-effective due to long-term mortgage financing, bulk purchases, standard installations and systems.

The public agency market is also attractive since public agencies have a much longer time horizon for recovering their investment. In addition, public agencies can aggregate and conduct group purchasing to reduce prices. For example, some of the most cost-effective systems installed in the past 5 years were the 4 MW of solar installed by the State of California at the fairgrounds. Their aggregated approach to procurement and installation allowed them to reduce the costs of the installed system to 48% well below the average market price.

Another strategy to increase the use of solar is to develop innovative financing mechanisms. Currently, several companies are offering third-party financing arrangements to purchase, install, maintain and own a photovoltaic system. The company then sells the solar-generated power to the “host” at a percent discount to below utility rates. This could enable public agencies to install photovoltaics on facilities with no up-front capital costs.

Major barriers continue to exist that inhibit the broad implementation of self-generation equipment. Among these barriers include: a) the availability of financing large capital projects, and b) the disconnect between the initial project capital outlay and the benefit (i.e. energy savings or production of energy to offset energy use), which may be derived over many years. Financing will be discussed in more detail later.

In fall 2001, voters in the City of San Francisco approved a ballot measure enabling the City to issue revenue bonds for the purchase and installation of energy efficiency, wind and photovoltaics. The City will service the bond debt with the energy savings realized through the energy projects. This is another strategy to deploy large amounts of photovoltaics, which could reduce costs and should be considered at a regional level.

One significant financial barrier is the disconnect between relatively high capital costs and the benefits that are derived from the systems over 10 to 20 years. For example, a home or business owner could install a costly solar system, move out of the property, and not fully recover the cost of the system in the sales price. One possible solution to this problem is the use of public financing through the County or region forming a special financing district under Government Code Section 16270 to provide “on tax-bill financing” of customer-sited renewable energy projects. This approach would link the project costs (initial capital and future payment stream) directly to the benefits (offsetting energy costs from the grid), eliminating the customer’s risk of installing a solar or self-generation system that they may

[23] The author feels that this estimated potential might be a reasonable practical potential, the actual technical potential is much larger.

only receive the benefit for a few years should they sell the property or move. This concept is discussed in more detail in Section 5 of the Plan.

4.3.3 Wind

According to American Wind Energy Association (AWEA), the growth in wind power generation capacity worldwide has quadrupled over the last 5 years. Technical advances have reduced the cost of wind electricity production as wind turbines have increased in physical size and power output. The average capacity of large wind turbines has grown from 150 kW to 750 kW in the past 20 years, with 1 to 2 megawatt (MW) machines becoming more common, and turbines as large as 6 MW are under development. California is home to three of the largest wind energy development areas in the world, including the Altamont Pass in Alameda County (544 MW); Tehachapi in Kern County (624 MW); and San Gorgonio Pass, north of Palm Springs (273 MW). Additional locations include Solano County (65 MW), Pacheco Pass, Merced, CA (16.4 MW) and 50 MW under development in San Diego County.

Small wind turbine capacities range from a few hundred watts up to 100 kW, producing electricity to supply homes, farms, and small businesses. Recently, the market for small wind turbines has been growing at about 40 percent a year. The region has 6 small wind turbines with a total capacity of 30 kW.

One of the disadvantages of wind energy is that its availability is highly variable and uncertain. The California ISO noted in its Summer 2002 report that wind resources in the State of California vary from 100 to 1,200 MW during peak hours. The availability factor is assumed for resource planning purposes to be about 20 percent.

The development of wind resources has largely been supported by a 1.5 cent per kWh federal wind energy Production Tax Credit (PTC), which was first enacted in 1992 and I currently being considered by Congress for an extension through 2010.

4.3.4 Concentrating Solar Power

Concentrating Solar Power (CSP), also known as solar thermal electric, uses reflective materials to concentrate sunlight onto a thermal receiver, which absorbs and converts it into heat. The heat is then used in a steam generator or engine to produce electricity. The three primary types of CSP systems currently being developed by U.S. industry are parabolic trough technology, dish/engine technology, and power tower technology.

The southwest United States has the greatest potential for CSP in the world. California is home to Solar Electric Generating Systems (SEGS), the world's largest CSP facility. The SEGS plants have a combined capacity of 354 MW, 75% of the total California concentrating solar power capacity (442 MW).

The SEGS facility (Figure 24) uses parabolic trough technology, in which solar energy is reflected from

Figure 24: Kramer Junction Solar Electric Generating System

mirrored troughs onto a receiving tube. The oil in the tube is heated to create steam, which powers a conventional turbine generator to produce electricity.

Dish/engine technology is best suited for small applications — in the 7-25 kW range. The technology consists of glass mirrors that focus solar energy onto a receiver in the center of the dish. The receiver contains fluid that is heated and used in an engine, which is attached to the receiver, to generate electricity. The most common dish/engine technology uses a Stirling engine, which takes the heat from the receiver to move pistons driving a generator to product electricity. One dish on an annual basis can produce 60,000 kWh of electricity. Put another way, a solar dish farm of 10.8 sq. miles could produce 2,100 MW of electricity annually – as much as the Hoover Dam, which uses 247 sq. miles of land (including Lake Mead)[24].

Power tower technology uses a large field of sun-tracking (heliostats) mirrors to concentrate solar energy onto a receiver on top of a tall tower (Figure 25). The receiver collects the heat to generate electricity through a conventional steam generator. Earlier power towers used steam as the heat transfer fluid while current systems use molten salt because of its efficiency and storage capabilities. There are many benefits of power tower technology including thermal storage capability, which allows energy to be dispatched to the electricity grid when power is needed. The technology can achieve load factors of up to 65 percent.

Figure 25: Solar Two, located near Barstow, CA, was a 10 MW power tower technology.

The estimated levelized cost of electricity from a 100 megawatt concentrated solar power parabolic trough system without storage will be about 12 cents/kWh in 2005, dropping as low as 6.4 cents/kWh by 2010.

4.3.5 Biomass

In California today, operating biomass and biogas electricity generation facilities use a range of organic waste material as fuel. Solid biomass fuels include woody agricultural wastes (e.g., orchard prunings, fruit pits, nut shells, and rice hulls); urban wood wastes (e.g., broken pallets, wood-product manufacturing wastes, and landscape trimmings); forest thinnings; and forest slash. Biogas fuel sources include landfill gas, dairy and swine manure, and sewage wastewater digester gas.

Producing electricity from solid organic waste materials greatly reduces emissions of particulate matter and other air pollutants relative to open field burning, controlled burns, or uncontrolled forest fires. Generating electricity from organic solid waste also reduces the amount of waste that is sent to landfills. Generating electricity from animal manure helps to control odor, pathogens, and wastewater discharges associated with animal waste.

[24] http://www.stirlingenergy.com/faq.asp?Type=all

The Energy Commission estimates that there are more than 800 MW of active biomass plants (including woody agricultural wastes, urban wood wastes, forest thinnings and slash, and MSW) in California. Beyond existing biomass facilities, the PIER program estimates that there is an additional 1,300 MW of technical potential available in California. Approximately 100 MW of biomass plants returned to service in 2001.

The Energy Commission estimates that there are more than 400 MW of existing biogas facilities and that an additional 200 MW of technical potential is available.

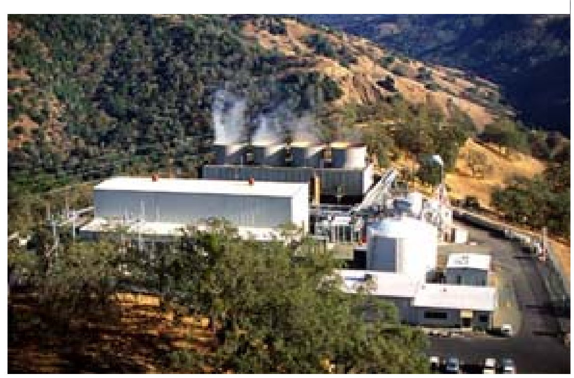
Landfill gas is competitive today and is a mature application of conventional technology, with cost and performance typically driven by the characteristics of internal combustion engines and small gas turbines. Because of the relatively small scale of the projects, development costs (i.e., project costs exclusive of equipment and installation) can be high on a per kW basis. The estimated levelized cost of electricity from a landfill gas facility in California is 4.4 cents/kWh in 2005, with the potential to drop to 3.7 cents/kWh by 2017. These estimates assume no Section 29 tax incentives, which have been a major driver for development in the past.

The County of Santa Cruz Department of Public Works is in the process of constructing a 1.97 MW landfill gas plant, which is expected to begin operation in late 2005.

4.3.6 Geothermal[25]

Geothermal energy is produced by the heat of the earth and is often associated with volcanic and seismically active regions. California has 25 known geothermal resource areas, 14 of which have temperatures of 300 degrees Fahrenheit or greater. Forty-six of California's 58 counties have lower temperature resources for direct-use geothermal (e.g. heating and cooling buildings). California's 44 geothermal power plants have a total capacity of 1,992 MW and produce about 6.4% of in-state generation, and about 5% of total state consumption. This also represents about 40% of the world's geothermal capacity.

Figure 26: The Geysers Geothermal Plant in Northern California.



The most developed geothermal resource areas in the state include the Geysers (located north of San Francisco) (Figure 26), Imperial Valley (east of San Diego) and the Coso Hot Springs area near Bakersfield.

The CEC estimates that the state has a potential of more than 4,000 megawatts of additional power from geothermal energy, using current technologies. The current cost of geothermal electricity is about 5.5 cents/kWh which is very competitive with most traditional sources.

[25] http://www.energy.ca.gov/geothermal/overview.html

The AMBAG region is not known to have suitable conditions to produce geothermal generation. It may, however, be suitable for geothermal space conditioning technologies.

4.3.7 Hydroelectric

Hydroelectric electric generation derives its energy from the potential energy derived from a difference in elevations (e.g. dams) or the kinetic energy derived from the flow of water in rivers or streams.

California has a total of 12,573 MW of hydro, consisting of 1,292 MW of small hydro (30 MW or less), and 11,281 MW of large hydro. Hydro produces about 17% of in-state generation, and about 13% of total state consumption.

Hydroelectric power falls into three categories: storage, pumped storage, and run-of-the river. Because of peaking and dispatch capability, storage and pumped storage provide the most benefits. These resources can be used for peak demand and system reliability. Run-of-river hydroelectric plants produce electricity at levels that vary with the amount of annual rainfall and snowfall.

Small and micro-hydroelectric facilities divert the natural flow of water through a channel or conduit to spin the turbine of an electrical generator and return the water downstream of the turbine. Hydroelectric power provides clean, renewable electricity and frequently other benefits such as habitat for fish and wildlife and opportunities for recreation. Despite this, generating electricity from the natural flow of water comes with negative environmental impacts. Changing water level, water temperature, and water quality can affect fish, plant, and animal life. Diversion structures and changes in water levels have an effect on fish movement. PIER is working to better understand the interactions between hydroelectric power generation and aquatic ecosystems. The areas of research include assessing the environmental effects of fluctuations in water flows, developing indices to assess the biological integrity of streams and rivers, and developing methods to forecast runoff to improve reservoir management.

The region has one know hydro facility - the 4.4 MW Nacimiento Hydroelectric Plant - operated by the Monterey County Water Resources Agency[26].

4.3.8 Ocean Energy

Ocean energy consists of tidal power, wave power, and ocean thermal energy conversion. Tidal power takes advantage of the gravitational pull of the moon and harnesses energy from the difference between high and low tides of 5 meters (16 feet) or more. A dam or barrage across a bay or estuary forces water through turbines that turn a generator and produce electricity. The largest tidal power project in the world is a 240 MW plant near Saint Malo, France. Currently, there are no tidal plants in the United States and none are planned; however, good tidal conditions exist in both the Pacific Northwest and Atlantic Northeast regions.

Wave power extracts energy directly from surface waves or pressure fluctuations

[26] http://www.mcwra.co.monterey.ca.us/

below the surface. All of the current technologies use mechanical power to activate a generator directly, to transfer energy to a working fluid, or air to drive a turbine/generator. Wave power densities in California coast waters are sufficient to produce between 7 and 17 MW per mile of coastline.

Many uncertainties still remain, despite the fact that wave power is nearing the end of the research and development phase. Cost and performance uncertainties must be overcome before large-scale investment will be attracted to the project development. Most wave energy technologies are being developed in Europe, and none have yet to develop a proven track record. Historically, generating costs of wave energy have been high but are predicted to be economic in niche markets such as near the end of a distribution grid or isolated areas not connected to the grid.

Ocean thermal energy conversion (OTEC) uses the temperature difference between the warmer top layer of the ocean and the colder deep ocean water. All OTEC facilities require that a costly large diameter intake pipe be submerged a mile or more into the ocean, bringing the colder water up to the surface. OTEC facilities require substantial upfront capital investment and will probably not attract private sector investors until the price of fossil fuel rises dramatically or significant government incentives are provided. Ocean energy technologies are quite expensive and cannot economically compete with traditional power sources. Permitting an ocean energy facility is also problematic. Some of the issues may include disturbance or destruction of marine life, possible threat to navigation from collisions, and degradation of scenic ocean views from energy devices and transmission lines located near or on the shore.

5 Financing Mechanisms

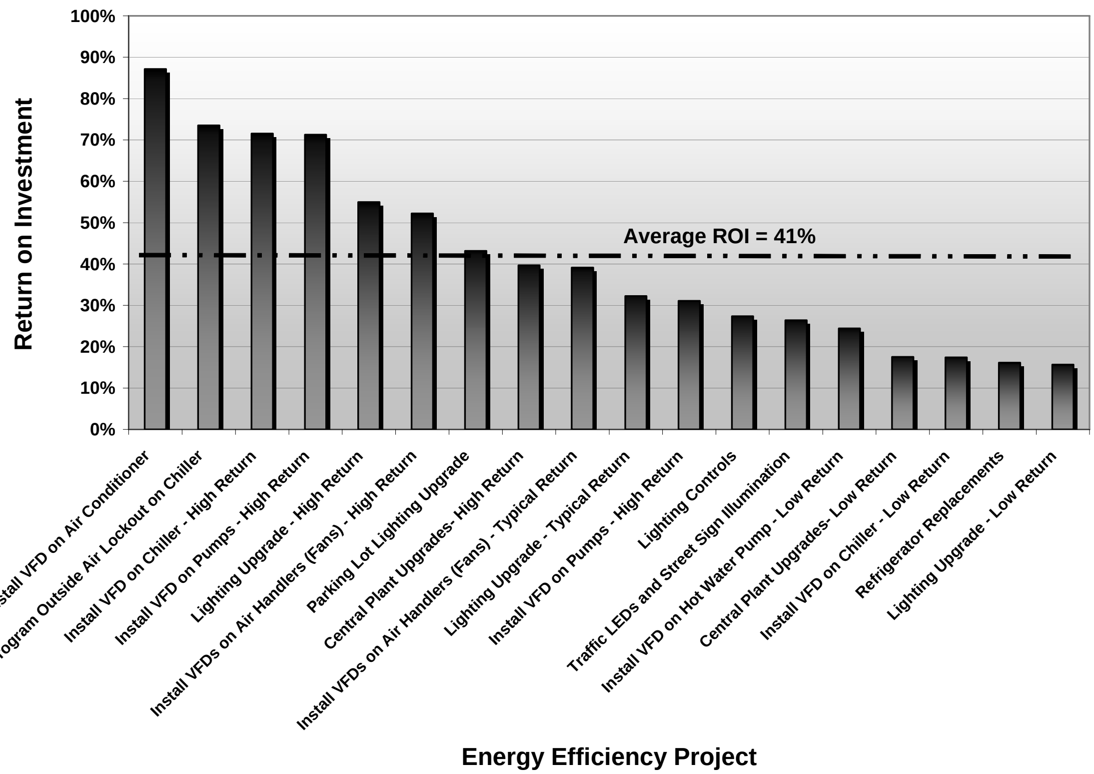
5.1 Background

One of the most significant barriers for local government agencies to completing energy efficiency projects is a perceived lack of funding. Furthermore, most new construction and building retrofit projects do no formal commissioning. First-cost and schedule concerns dominate the design and construction process. This is particularly true during periods where budgets are tight. This is the time that public agencies most need to invest in energy efficiency projects since energy efficiency is one of the few investments that can generate a reliable and predictable cost savings. Public agencies have a wide range of funding options available to them to finance energy projects. If an agency pays an electric or natural gas bill, it has the financial resources to improve its energy efficiency.

With energy prices being at all-time highs, energy efficiency is not just a good idea, it is a smart investment of taxpayer dollars. Some energy efficiency investments can take 4 to 5 years or more to recover their investment, while others pay for themselves in 1 to 2 years or less. Energy cost savings can quickly become a sorely needed revenue source to fund other priority public services, like libraries, public safety or civic projects. Most importantly, the dollars saved can stay in the local economy.

Figure 27 lists the rate-of-return of several typical energy efficiency retrofits found recently in public agencies.

Figure 27: Return-on-Investment of Typical Public Agency Energy Efficiency Projects (Based on public agency projects during 2005)



5.2 Measuring Project Cost-Effectiveness

5.2.1 Simple Payback

The time required to recover the initial project costs from an energy project cost savings is called simple payback. It is the most commonly used method to evaluate cost-effectiveness since it is easy to calculate and understand. Simple payback is an acceptable measure for only shorter-term investments since it does not account for the time-value of money. A $100,000 project that produced an annual savings of $50,000 would have a two-year simple payback. Ideally, the quicker the payback, the more attractive the project investment.

5.2.2 Rate-of-Return/Return-on-Investment (ROI)

ROI is the percentage of an investment that is paid back each year. ROI is also acceptable only for shorter-term investments since it does not account for the time-value of money. A $100,000 project that saves $50,000 each year has a 50% rate of return or return on investment (ROI). In business, a 10 to 12 percent ROI is considered acceptable. Most energy efficiency projects have an ROI in excess of 15%.

5.2.3 Life-Cycle Cost and Value Engineering

The most comprehensive and accurate measure of a project's cost-effectiveness is lifecycle cost, since it captures all savings and cost over a project's life, including all operating costs (e.g. maintenance, utilities, replacement, and disposal). This method involves more research and analysis than calculating simple payback or ROI. If the Net Present Value (NPV) of all the future benefits is greater than costs, the project is considered cost-effective.

Value engineering takes into account the value of a system's outputs optimized by both performance and costs. Many project managers mistake value engineering principals to assume that project first costs must always be reduced. The goal is to identify and remove unnecessary expenditures over the life of the project, while improving overall quality and performance, thereby increasing overall value.

5.3 Energy Financing Options

5.3.1 Energy Efficiency Loans

CEC Low-Interest Loans

The California Energy Commission offers low-interest loans for installing energy cost-saving projects, with an incentive for completing a project within 12-months. Cities, counties, special districts, and public schools, public care institutions, and public hospitals are eligible to apply. The maximum loan amount is $3 million per application.

Projects with proven energy and/or capacity savings are eligible. Common projects include energy efficiency upgrades to lighting systems; heating, ventilating and air conditioning systems; light emitting diode traffic signals; energy management systems and equipment controls; cogeneration systems; pumps and motors; and renewable energy projects. Energy audits and feasibility studies may be eligible for loans in some cases.

The requirements of the program are as follows:

- Projects must demonstrate technical and economic feasibility.
- Loans must be repaid within 15 years, including principal and interest (approximate 9.8 years simple payback). Loans for energy audits/studies must be repaid within two years.
- The loan term cannot exceed the useful life of loan-funded equipment.
- Projects may start once the application is on file with the Energy Commission. However, only approved project related costs with invoices dated after loans are officially awarded by the Energy Commission at a Business Meeting are eligible to be reimbursed from loan funds. If your application is rejected for any reason, the Energy Commission is not responsible for reimbursement of any costs.

Contact the Energy Commission's Public Programs Office at (916) 654-4147 or the CEC web site (http://www.energy.ca.gov/efficiency/financing/) for information regarding eligibility.

Utility On-Bill Financing

The utilities, including PG&E, are in the process of developing a streamlined, low-interest, on-bill financing program for energy efficiency projects. Details were not available at the time of writing the Plan.

5.3.2 Lease Financing

Lease Purchase Agreements

Lease Purchase Agreements (LPAs) are a popular option for financing energy projects. LPAs are flexible, tax exempt, fixed-rate financing instruments available to county and municipal entities. LPAs are deemed to be "operating," not debt instruments despite going out for 3-12 year terms, and are fully amortizing. LPAs are often referred to as "conditional sales contracts" that convey ownership to the lessee, subject to a security interest. LPAs typically offer master leases that cover multiple classes of buildings and various types of equipment. LPAs tend to have a higher cost of financing because they incorporate "non-appropriation" risk. This works in favor of the municipality however, because the non-appropriation clause means the financing is not seen as debt. This makes it much easier to acquire financing, and frequently the reduced transaction costs more than offset the slightly higher interest rate of leases over bonds.

The further advantages of lease purchase agreements include: no negative impact on cash flow; avoidance of costly and time intensive bond issues; no referendums; no budget restructuring; ownership benefits are retained; financing begins at levels of as low as $50,000; and no added pressure to debt limitations of local governments.

5.3.3 Pooled Bond Financing

Pooled bond programs help reduce the costs of issuing bonds. In pooled bond arrangements, usually a small group of borrowers can pool their financing needs together and issue a single bond. Several local government associations and/or joint powers authorities in California offer pooled bond programs, as follows:

ABAG Credit Pool

The ABAG Finance Corporation is a nonprofit public benefit corporation created by the Association of Bay Area Governments (ABAG) for the purpose of aiding the financing of projects for members and cooperating members of ABAG. The corporation's articles of incorporation and bylaws empower it to act as a lessor in financing for participating public entities. Funding requests are combined so that transaction costs and market interest rates are significantly lowered for all borrowers. Credit Pooling is ABAG's longest running financial services program. To date, 42 credit pools have funded over 120 projects totaling more than $250 million. See http://www.abag.ca.gov/services/finance/pooling/pooling.htm

California Statewide Communities Development Authority (California Communities): League of California Cities and California State Association of Counties

The California Statewide Communities Development Authority (CSCDA), more commonly known as "California Communities" or "Cal Statewide" is a joint powers authority sponsored by the California State Association of Counties and the League of California Cities. California Communities was created to provide local governments and private entities access to low-cost, tax-exempt financing for projects that create jobs, help communities prosper and improve the quality of life in California. California Communities has issued more than $20 billion in tax-exempt bonds since its creation in 1988. See http://www.cacommunities.org/

Community Energy Authority (CEA)

A CEA is a special-purpose joint powers authority that allows a city or county or groups of cities and counties to join forces to accomplish long-term energy efficiency planning and project development (California Government Code (Community Energy Authority Act, Sections 52030-52190)). A Community Energy Authority (CEA) is formed as a Joint Powers Authority (JPA) under the (California Joint Powers Act (Chapter 5 Section 6500). A CEA can issue bonds for the purposes of accomplishing energy efficiency, renewables and self-generation projects. A CEA is not a municipal utility, and has restrictions on any activities related to the formation and operation of a municipal utility.

5.3.4 Performance Contracting

Energy Service Companies (ESCOs)

For those municipalities with no capital and no expertise available to implement energy retrofits, ESCOs represent one of the best solutions. ESCOs are highly specialized firms that retain detailed engineering knowledge, and usually have strong financial partners.

Often, the ESCO will offer a performance "guarantee"- which can take several forms. The guarantee usually is tied to the actual flow of energy savings from a retrofit project. Alternatively, the guarantee can stipulate that the energy savings will be sufficient to repay monthly debt service costs. ESCOs often claim “guaranteed” project performance. There is a cost to this guarantee- approximately 8 to 10% of total financing costs, but this aspect does mitigate some portion of the project risk for those clients who are risk averse.

5.3.5 Revolving Fund

Many agencies are beginning to develop what is referred to as a “revolving fund” which provides continuing long-term financial support to energy efficiency improvements. A revolving fund is an administrative arrangement in which all or a portion of the money that is saved from the implementation of energy efficiency projects is reinvested into the energy fund. Funds set aside in the energy program’s revolving fund still go through the annual appropriation process, therefore, staff must be diligent about documenting savings.

The steps to forming an energy fund include:

1. The energy program is initially funded from the agency's general fund, or as a grant or loan from a state or federal agency. Funding may also be obtained by collecting operational savings. This initial funding then becomes a "bank account" from which energy projects in the agency's facilities are funded.

2. As energy efficiency projects are completed, the dollar value of the energy savings resulting from the funded energy projects are reinvested in the bank account.

3. The energy program then uses this money to provide additional funding for subsequent energy projects.

Once the program is funded, there are several options for utilizing the money. First, debts or loans are repaid. You can decide to leave all remaining funds in the energy account. Funds can be shared with other departments that assist in completing the energy savings projects. Lastly, funds can be shared with the general fund to fund other public services.

Most energy efficiency projects repay the money invested in them several times over through realized energy savings. The savings from an energy efficiency project will not only repay its installation costs, but can also provide additional funds for subsequent projects. However, it is important to recognize that these savings will not be returned to the agency in the form of cash. Rather, these are "avoided costs" – or energy costs that the agency no longer has to pay, due to successfully completed energy efficiency projects. The savings can be reliably estimated before an energy project is installed and then accurately tracked when it is fully operational. It is this specific characteristic of energy efficiency projects that makes the energy revolving fund possible, and that permits an on-going program of self-financed energy efficiency to work successfully.

If implemented properly, revolving funds work. Two case studies are the City of Phoenix and the City of Edmonton (Alberta, Canada). In 1995, the City of Edmonton created a revolving fund aimed at energy retrofits of City facilities. This fund initially started at $1 million dollars and was increased in 1999 to $5 million. In 2002, City Council approved an increase in the fund limit of up to $30 million, to be financed from the Alberta Municipal Finance Corporation (AMFC). The $30 million fund is set aside for energy efficiency projects such as upgrades to lighting, heating, cooling and ventilation systems and envelope upgrades. The amount borrowed against the fund for these projects is repaid over a period of up to eight years (up to 10 years by exception) out of the utility savings making this money available for other energy projects.

5.3.6 On Tax-Bill Financing

Major barriers continue to exist that inhibit the broad implementation of cost-effective demand-side energy projects, including energy efficiency upgrades and installation of self-generation equipment (e.g. solar, combined heat and power, etc). Among these barriers include: a) the availability of financing large capital projects, and b) the disconnect between the initial project capital outlay and the benefit (i.e. energy savings or production of energy to offset energy use), which may be derived over many years.

Several Counties throughout California are currently evaluating formation of an On Tax-Bill Financing (OTBF) Mechanism. The OTBF would be a new form of special district under

Government Code Section 16270 that would allow for Counties to provide "on tax-bill financing" of customer-sited energy efficiency and renewable energy projects. The proceeds will be used to provide financing to qualified energy efficiency or self-generation projects at commercial or residential facilities.

The costs for a qualifying project (including administration and finance charges), will be recovered from the specific consumers that host sustainable energy projects through a special tax assessment on the property that receives the benefits of the energy efficiency project of the self-generation system. The tax assessment, or lien, would remain with the property through the sale of the property and this assessment would continue for the life of the project benefits.

This approach would allow the linking of the project costs (initial capital and future payment stream) directly to the benefits (offsetting of higher-costs energy from the grid), eliminating the risk of a consumer to a install a self-generation system that they may only benefit from for a few years.

From the tax payer's perspective, only those that directly benefit from OTBF services would pay for them. The OTBF will be funded either through the local County issuance of revenue bonds or a State Renewable Energy Bank.

OTBF would be a County Service Area, single function, enterprise district. While many Counties have expressed interest in this idea, the challenge would be that it would require a ballot initiative in every County that would like to take advantage of the concept. An alternative is to introduce legislation that would change or augment the Government Code to allow Counties to adopt such a program at their discretion. This legislation could possibly be attached to anticipated legislation that would be introduced as part of the State Energy Plan which includes significant emphasis on the promotion of self-generation as well as innovative financing mechanisms.